A Multi-scale, Multi-objective Approach for Using Indicators to Enhance State-level Conservation and Restoration Programs

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Maryland Department of Natural Resources
Landscape and Watershed Analysis Division

Maryland's Integrated Natural Resource Assessment

Statewide assessment to identify…

- *Where are those remaining resources we value as important?*
- *What stressors currently or potentially impact these valued resources?*
- *Where should our collective programmatic responses be focused to get the greatest benefits?*

United States
Environmental Protection
Agency

Office of Research and
Development
Washington DC 20460

EPA/600/R-97/130
November 1997

EPA

An Ecological Assessment of the United States Mid-Atlantic Region

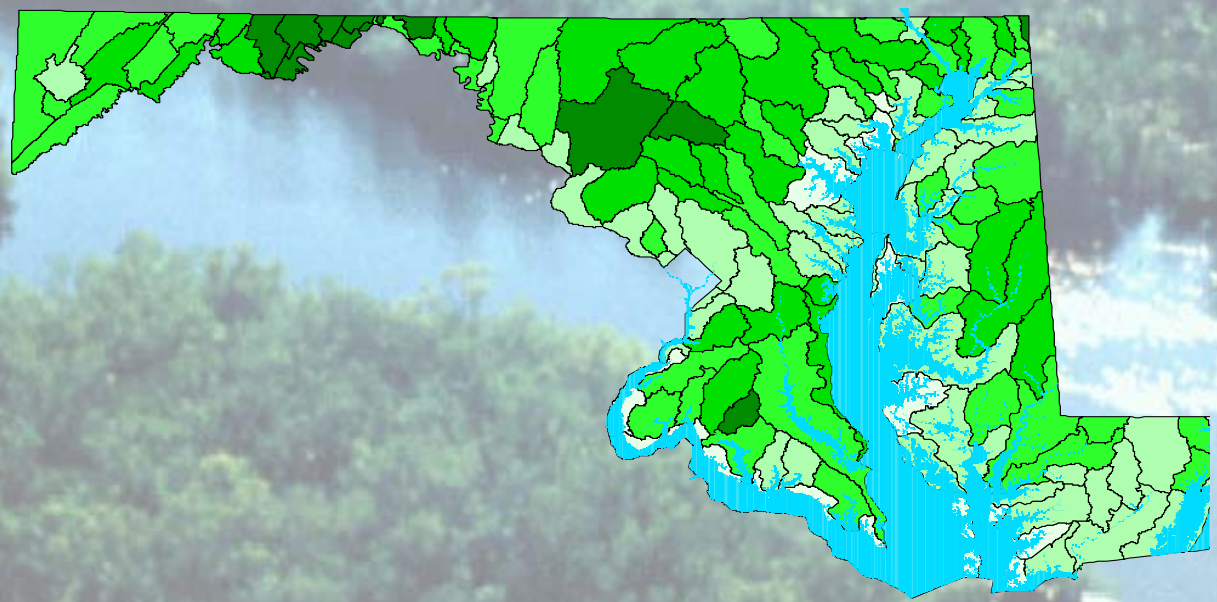
EMAP TVA

Maryland's Integrated Natural Resource Assessment

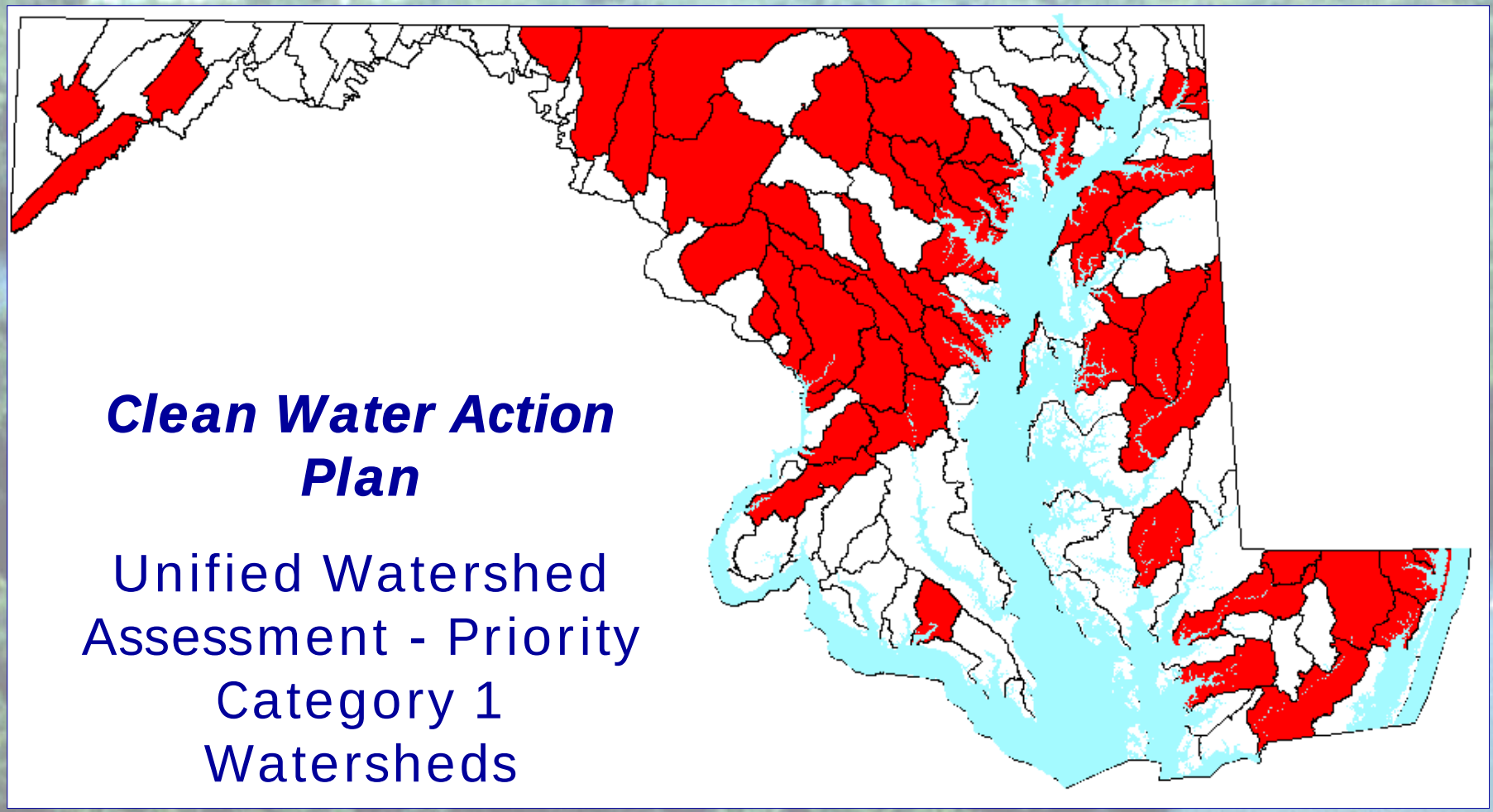
INRA Analytical Components

- *Comparative Watershed Assessment*
- *Green Infrastructure Assessment*
- *Strategic Forest Lands Assessment*
- *Landscape/Watershed Restoration and Conservation Targeting Tools*

Comparative Watershed Assessment

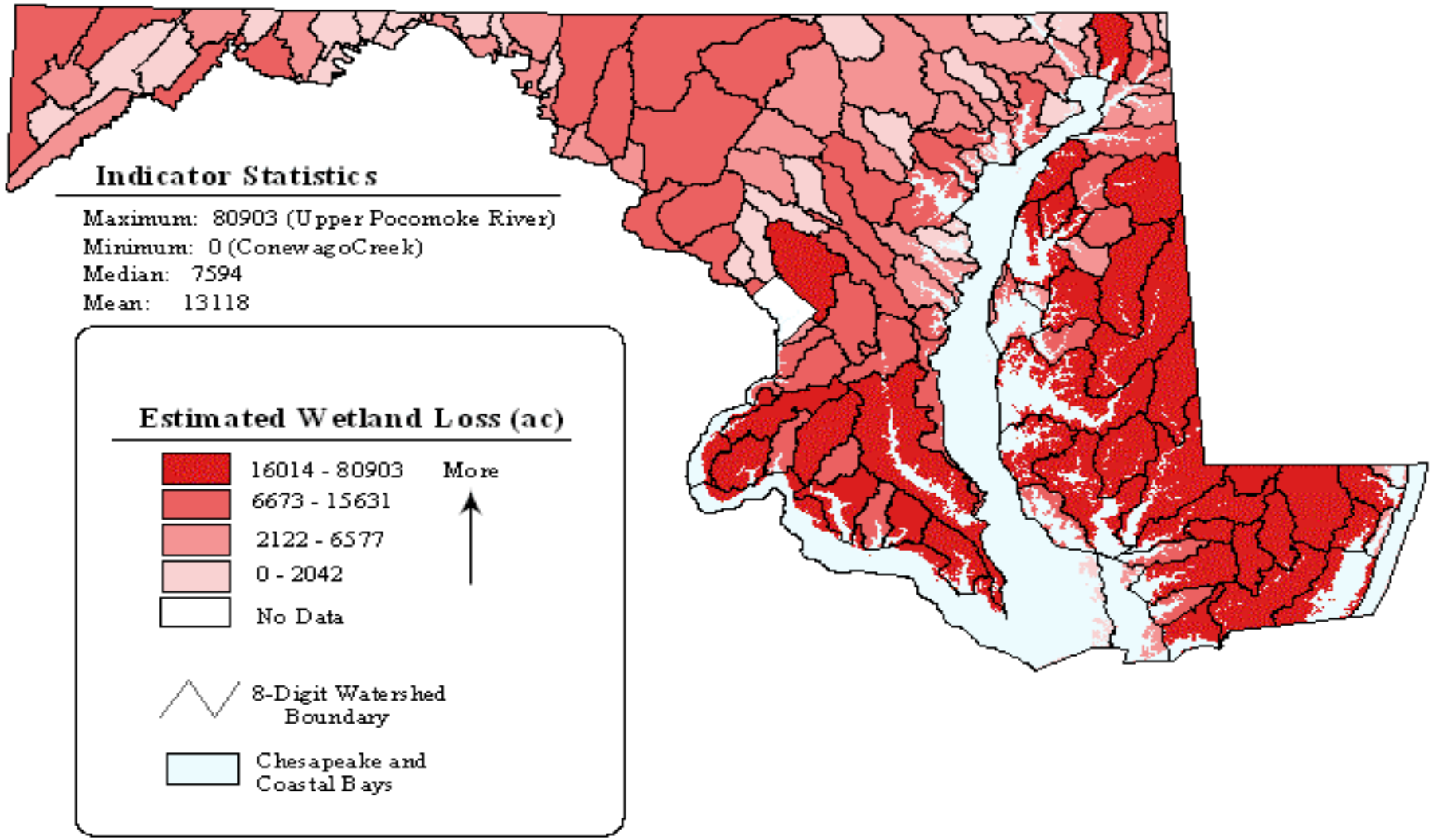


Comparative Watershed Assessment: CWAP



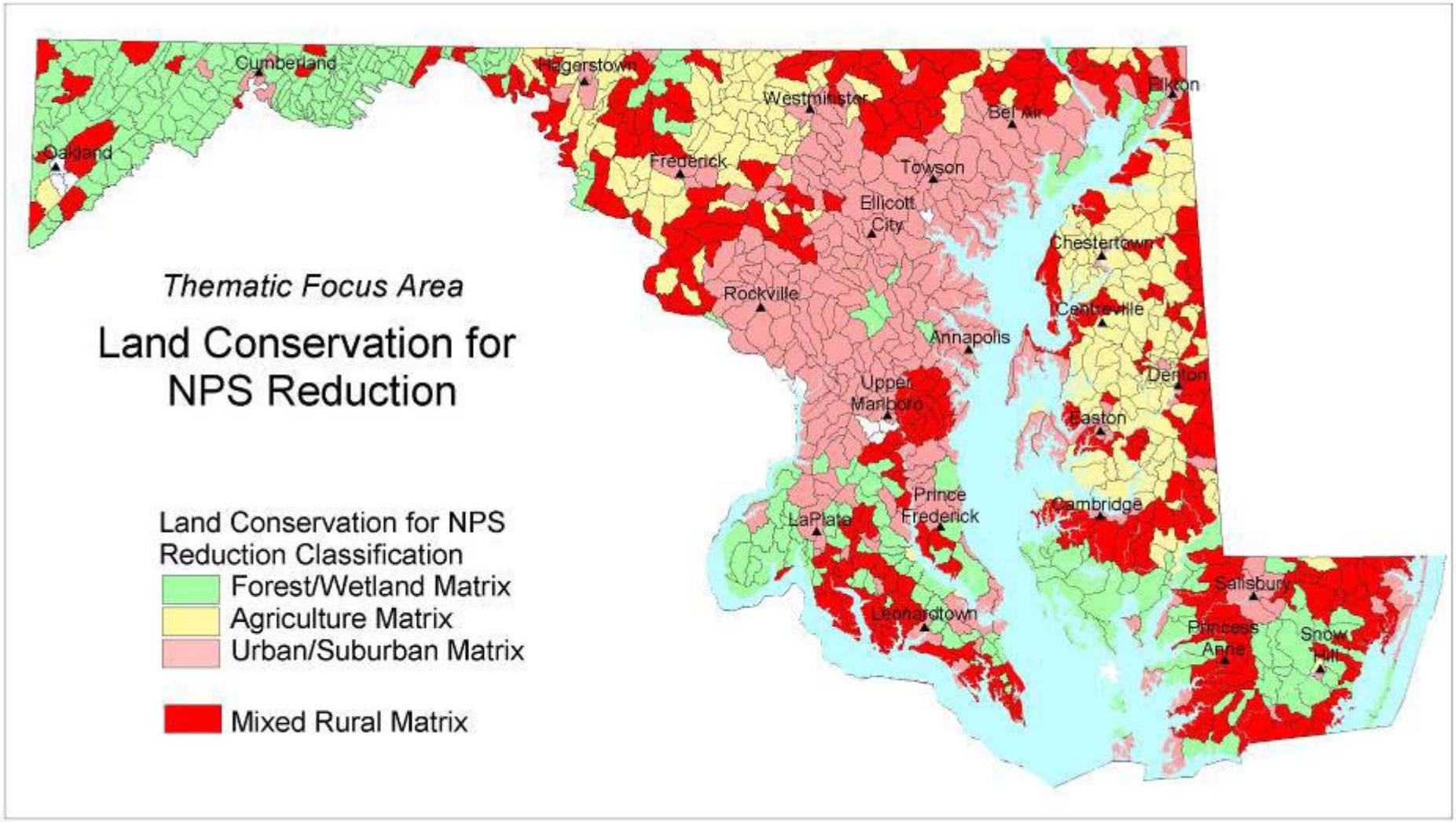
Clean Water Action Plan

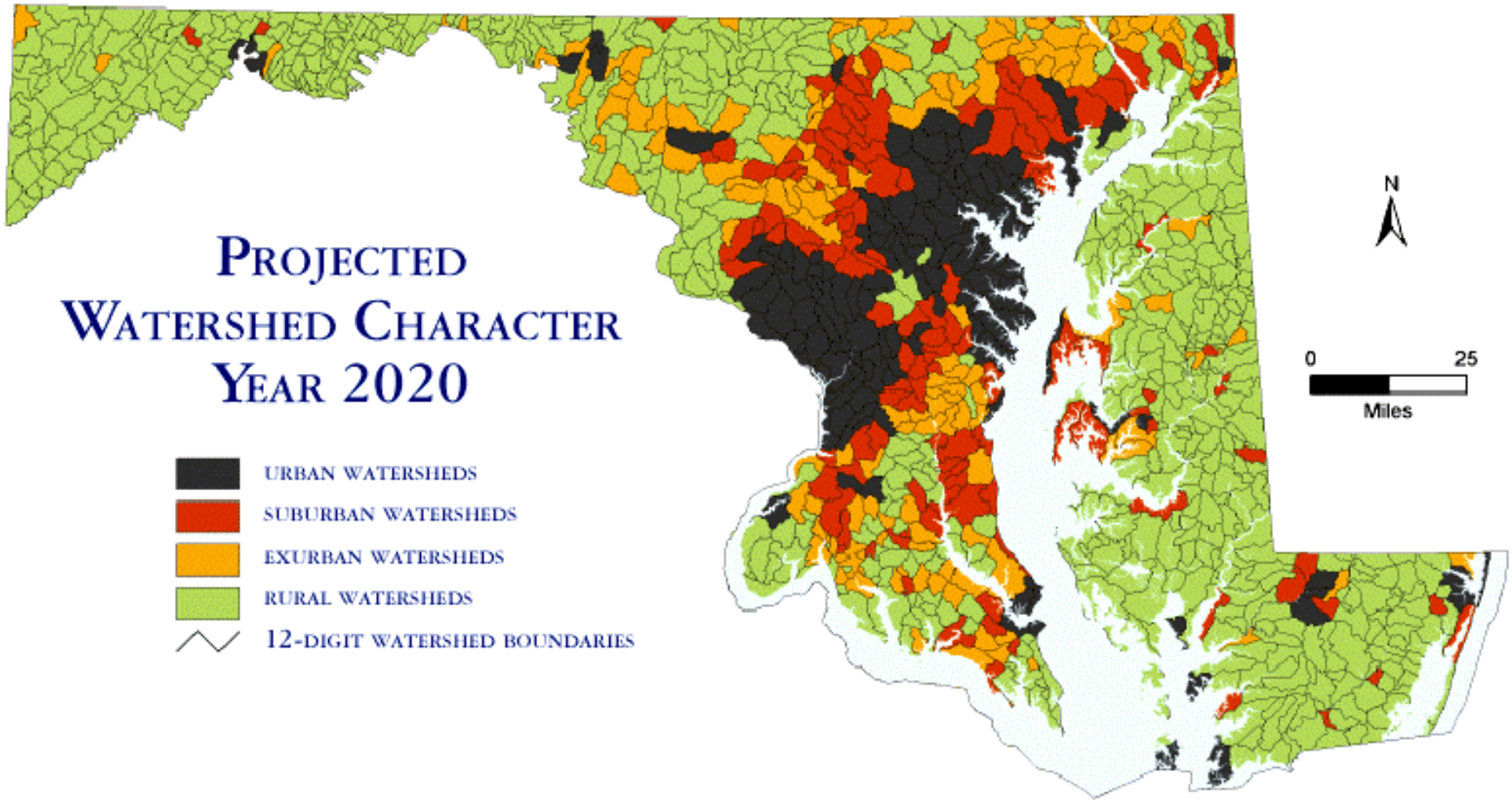
Unified Watershed Assessment - Priority Category 1 Watersheds


Indicator Statistics
Maximum: 80903 (Upper Pocomoke River)
Minimum: 0 (Conewago Creek)
Median: 7594
Mean: 13118
Estimated Wetland Loss (ac)
16014 - 80903
6673 - 15631
2122 - 6577
0 - 2042
No Data
More
8-Digit Watershed Boundary
Chesapeake and Coastal Bays

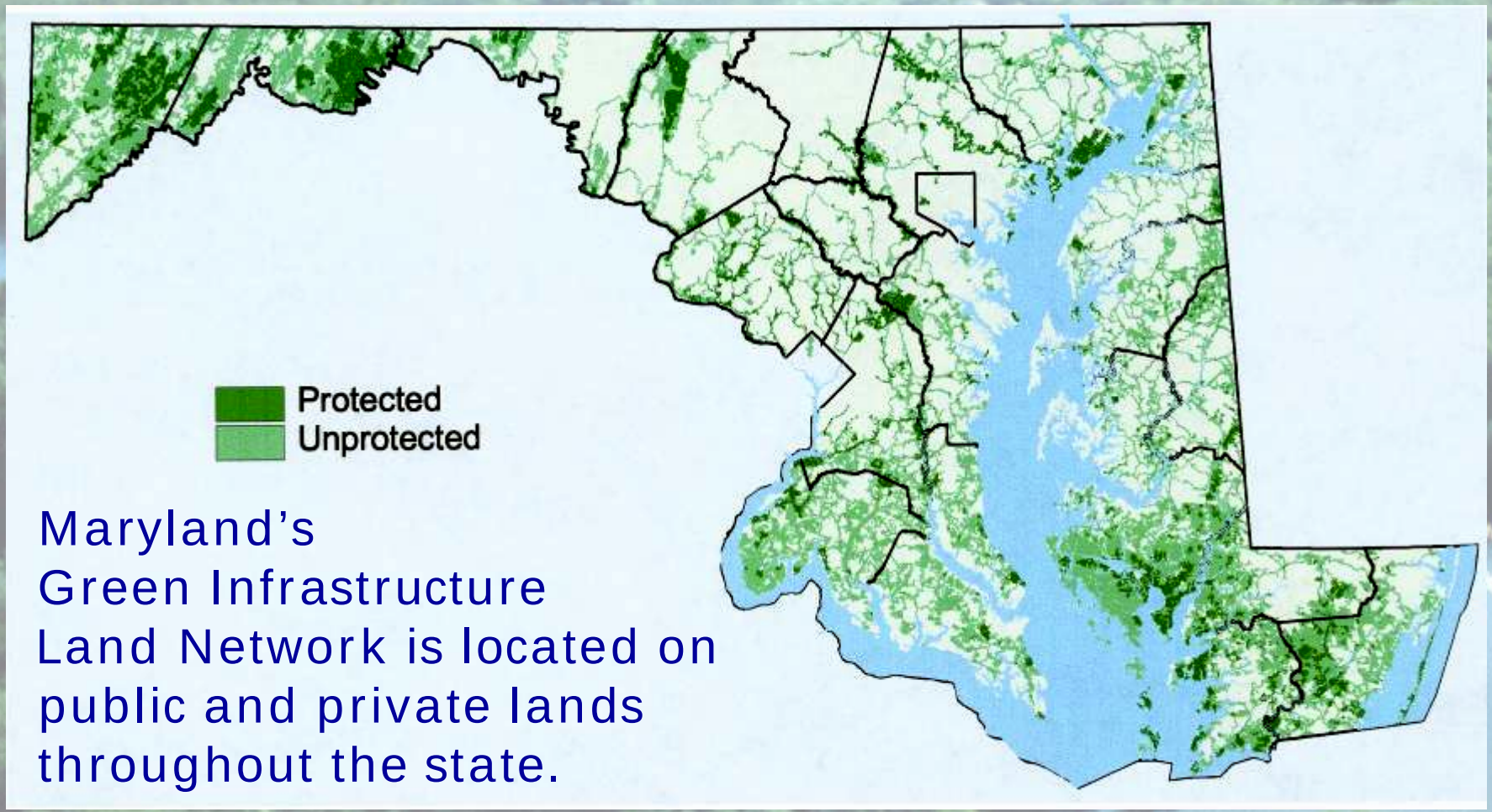
Watershed Approach – Comparative Watershed Assessment: Land Conservation for Nonpoint Source Pollution Reduction

- Maximize effectiveness of land conservation (and subsequent restoration) for watershed management
- Rationale
  - Natural – largely intact, impacts of additional land protection minimal
  - Urban – largely disturbed, impacts of additional land protection minimal
  - Mixed – greatest potential for habitat protection/enhancement and associated water quality improvements


Cumberland
Hagerstown
Westminster
Bel Air
Elkton
Oakland
Frederick
Towson
Ellicott City
Chestertown
Rockville
Centreville
Annapolis
Upper Marlboro
Denton
Easton
Prince Frederick
LaPlata
Cambridge
Salisbury
Leonardtown
Princess Anne
Snow Hill
Thematic Focus Area
Land Conservation for NPS Reduction
Land Conservation for NPS Reduction Classification
Forest/Wetland Matrix
Agriculture Matrix
Urban/Suburban Matrix
Mixed Rural Matrix


Projected
Watershed Character
Year 2020
URBAN WATERSHEDS
SUBURBAN WATERSHEDS
EXURBAN WATERSHEDS
RURAL WATERSHEDS
12-DIGIT WATERSHED BOUNDARIES
N
0
25
Miles

Landscape Approach:
Green Infrastructure Assessment
Strategic Forest Lands Assessment

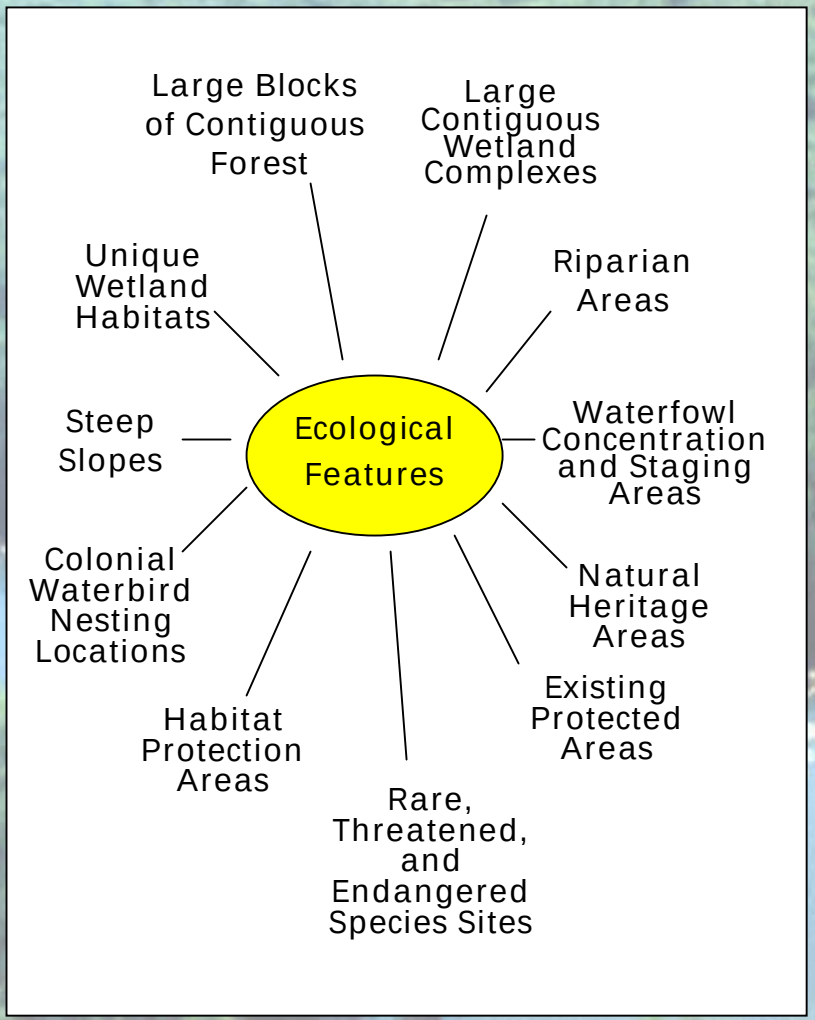


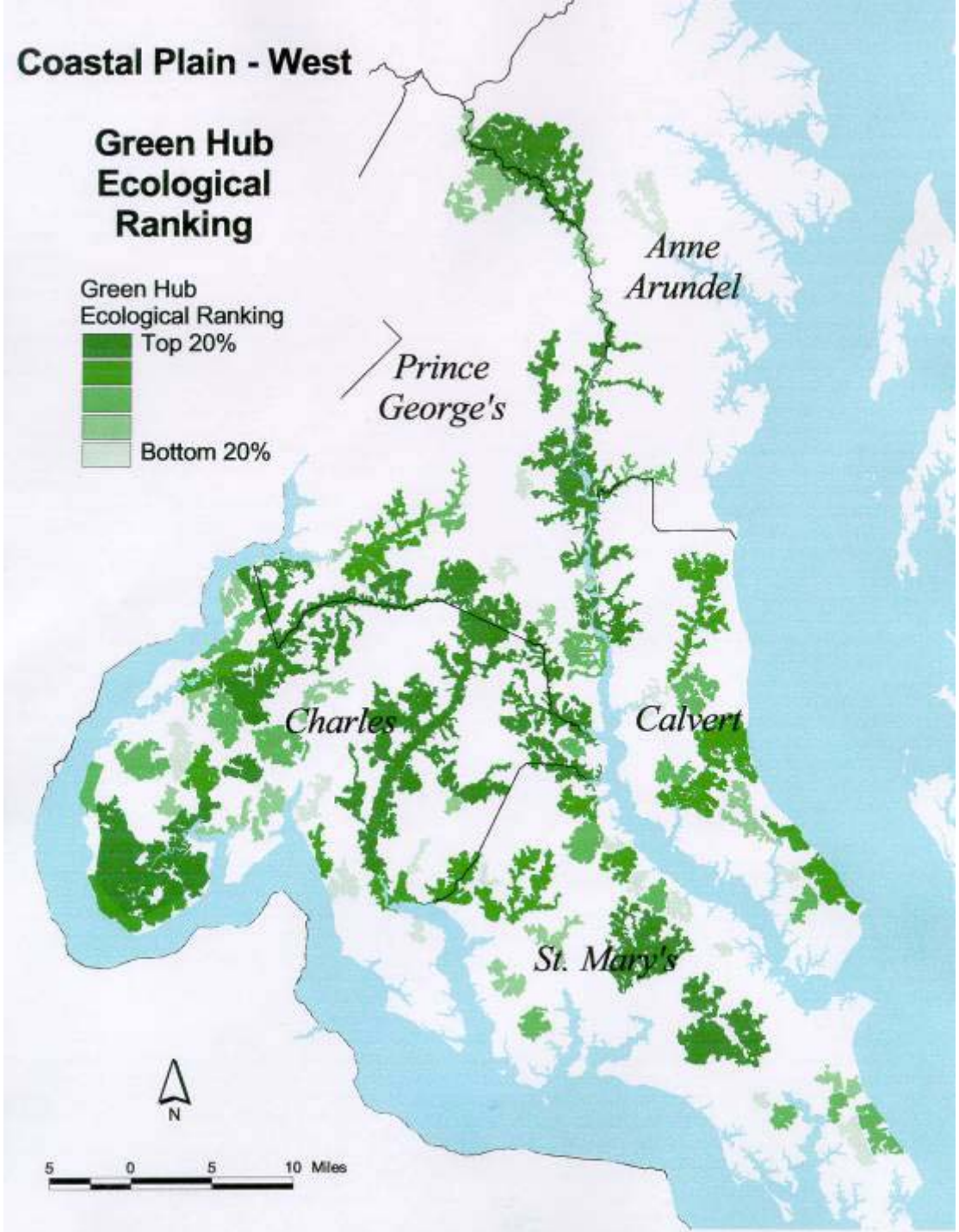
Maryland's Green Infrastructure Land Network is located on public and private lands throughout the state.

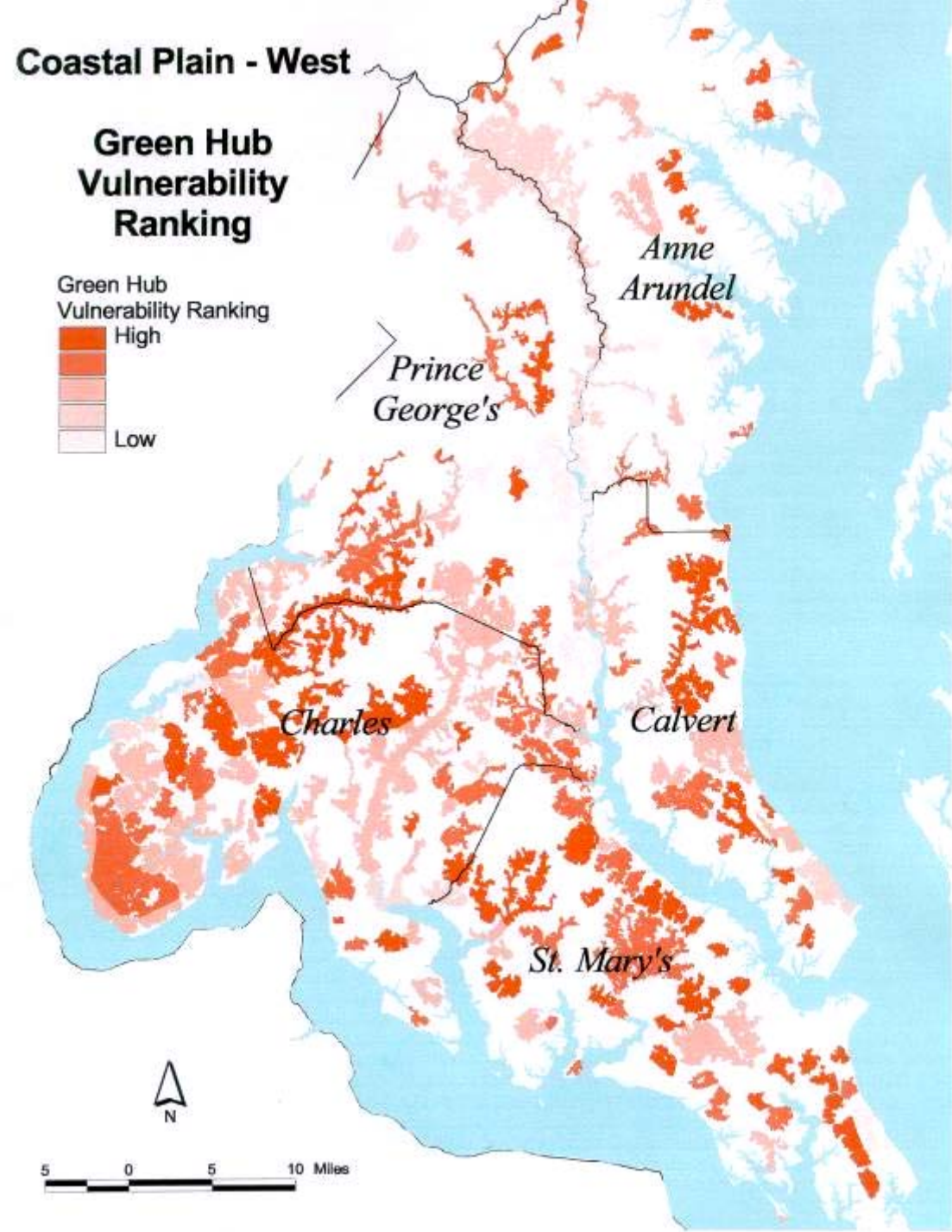
Maryland's GreenPrint Program

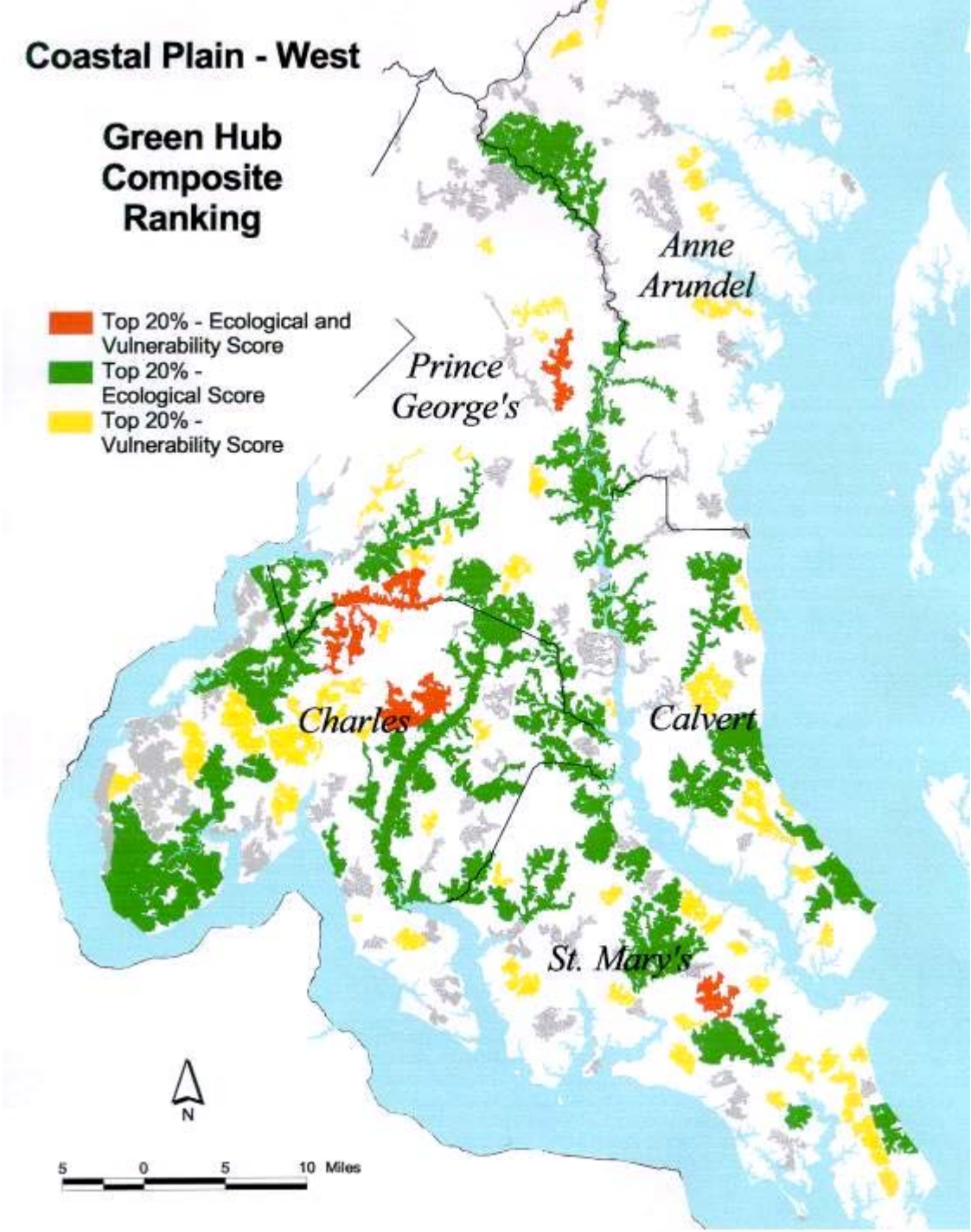
Green Infrastructure Assessment: Selection of Ecological Components

- Incorporate landscape ecology and conservation biology principles
- Coarse scale analysis
- Strive to include full range of ecosystem elements
- Limited to features with GIS data available statewide




Coastal Plain - West
Green Hub Ecological Ranking
Green Hub Ecological Ranking
Top 20%
Bottom 20%
Anne Arundel
Prince George's
Charles
Calvert
St. Mary's
N
5 0 5 10 Miles


Coastal Plain - West
Green Hub Vulnerability Ranking
Green Hub Vulnerability Ranking
High
Low
Anne Arundel
Prince George's
Charles
Calvert
St. Mary's
N
5 0 5 10 Miles


Coastal Plain - West
Green Hub Composite Ranking
Top 20% - Ecological and Vulnerability Score
Top 20% - Ecological Score
Top 20% - Vulnerability Score
Anne Arundel
Prince George's
Charles
Calvert
St. Mary's
N
5 0 5 10 Miles

GreenPrint Parcel Evaluation

Acres of Green Infrastructure (GI)

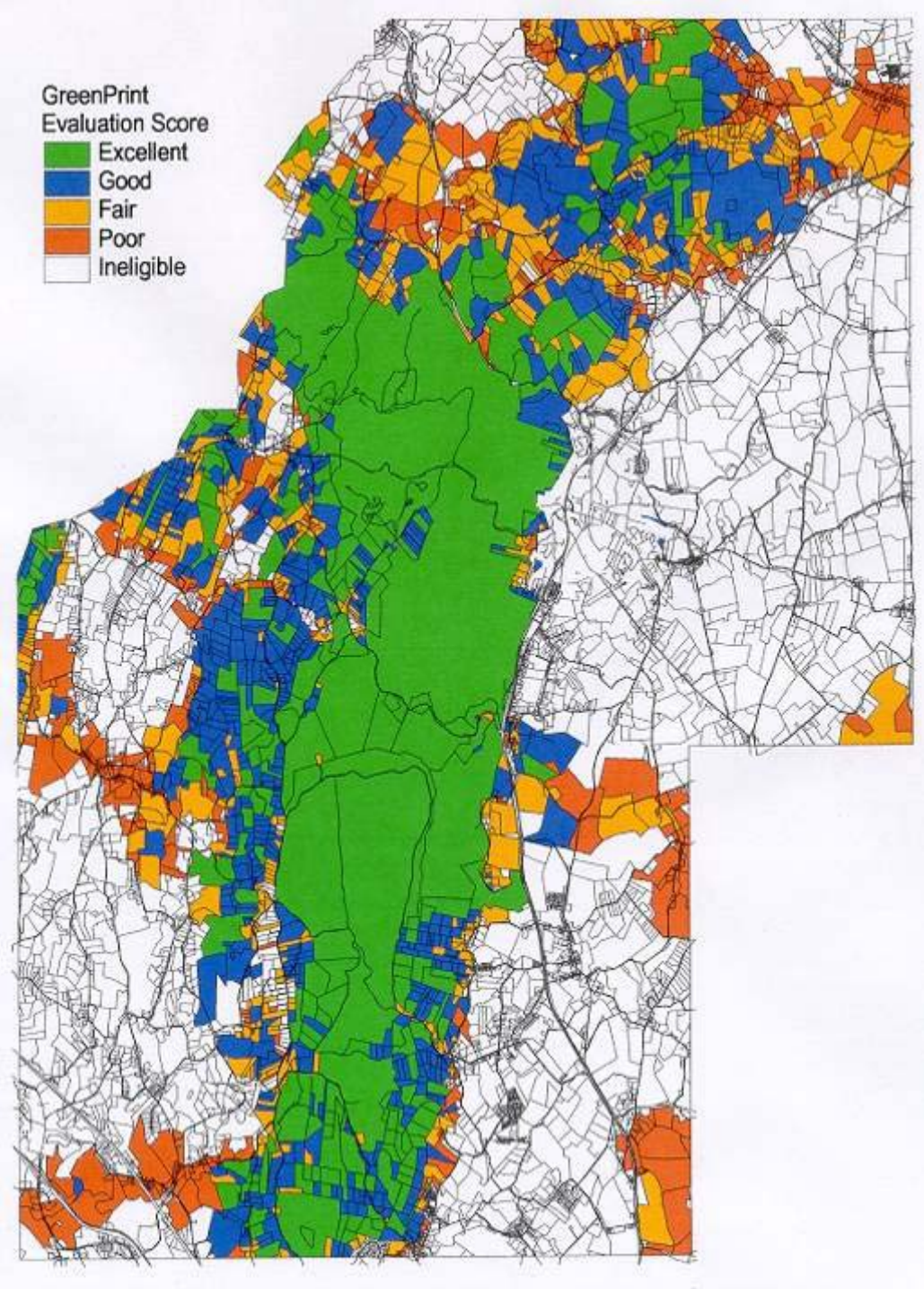
Percent of Parcel in GI

Ecological Score of GI within Parcel

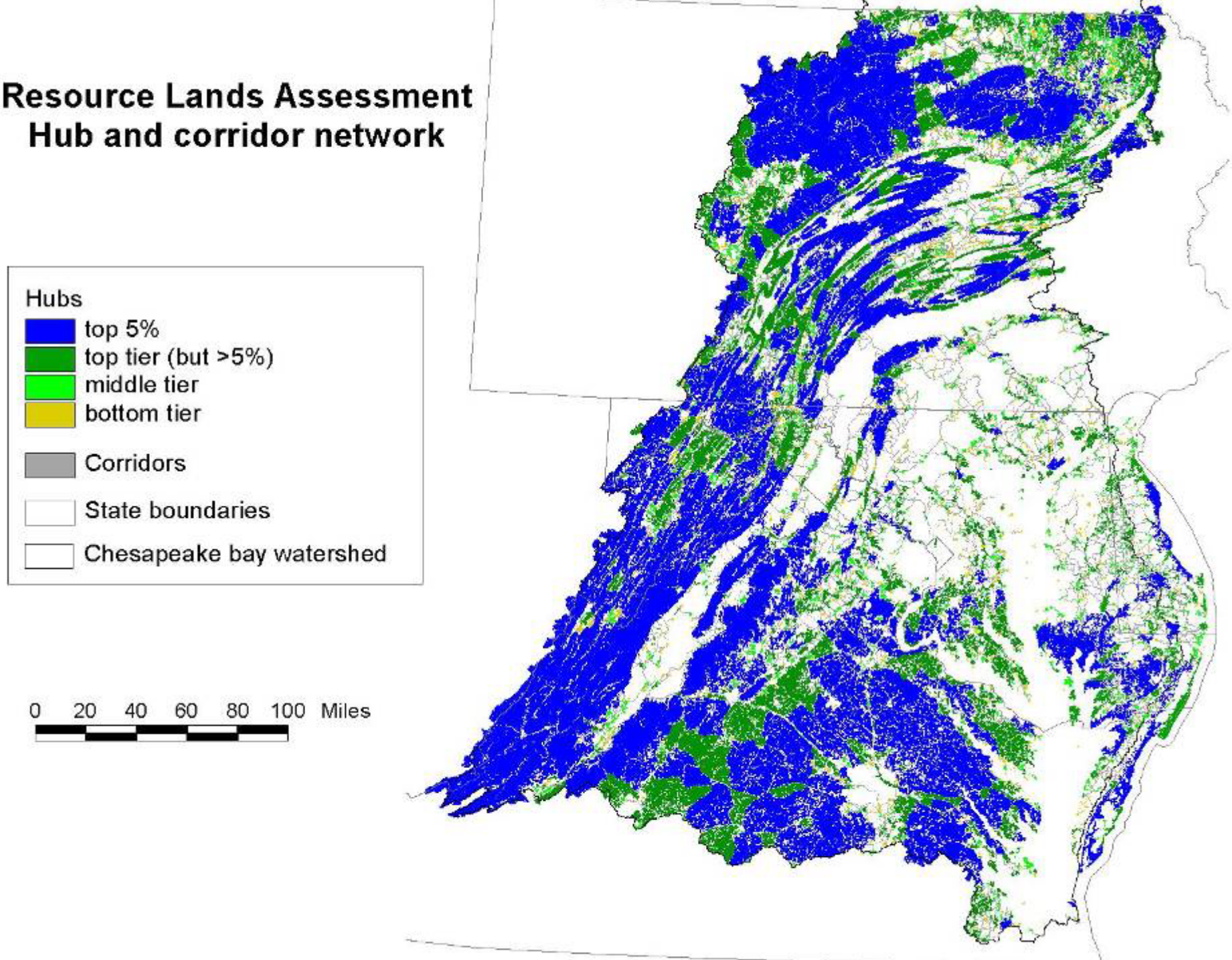
Acres of Protected Land within 1 Mile

Contribution to Protection of Hub or Corridor

Composite Score



Resource Lands Assessment
Hub and corridor network



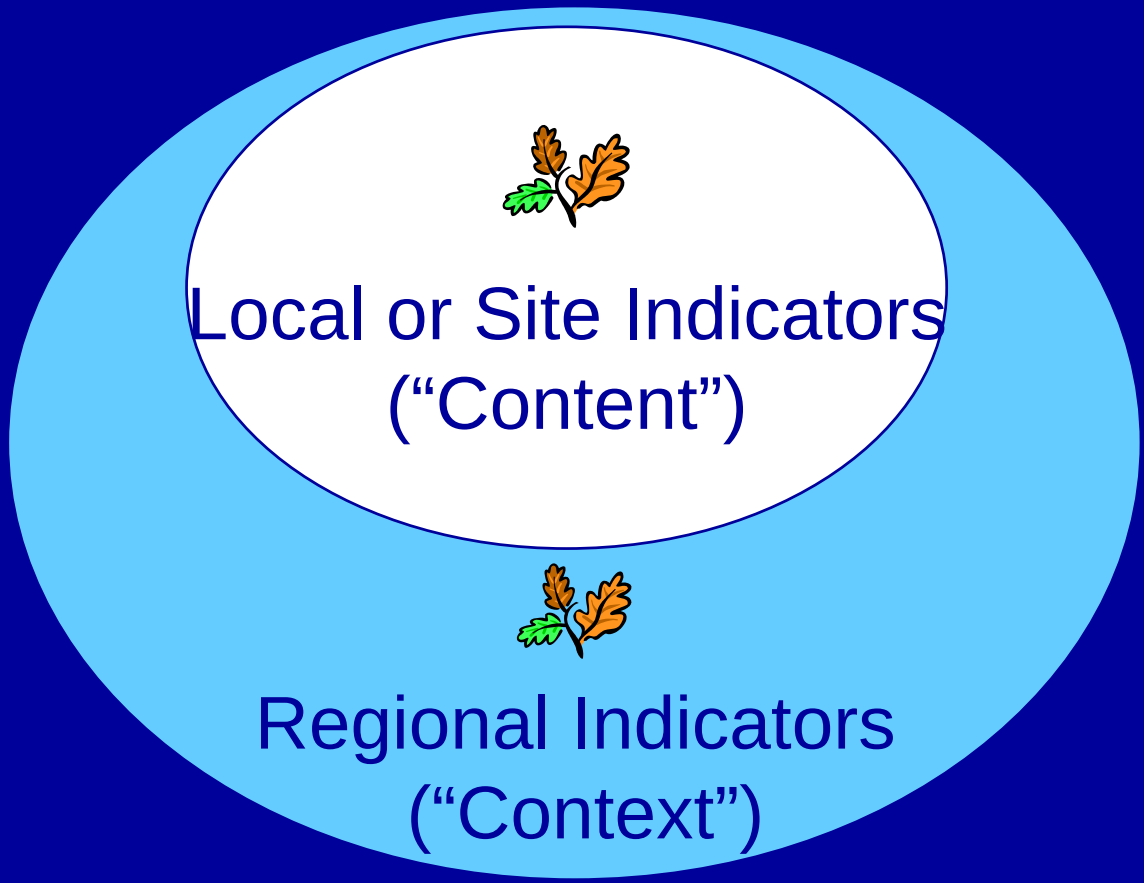

s f l a
Maryland's
Strategic Forest Lands Assessment

Strategic Forests - GIS Modeling Approach- Scale Issues

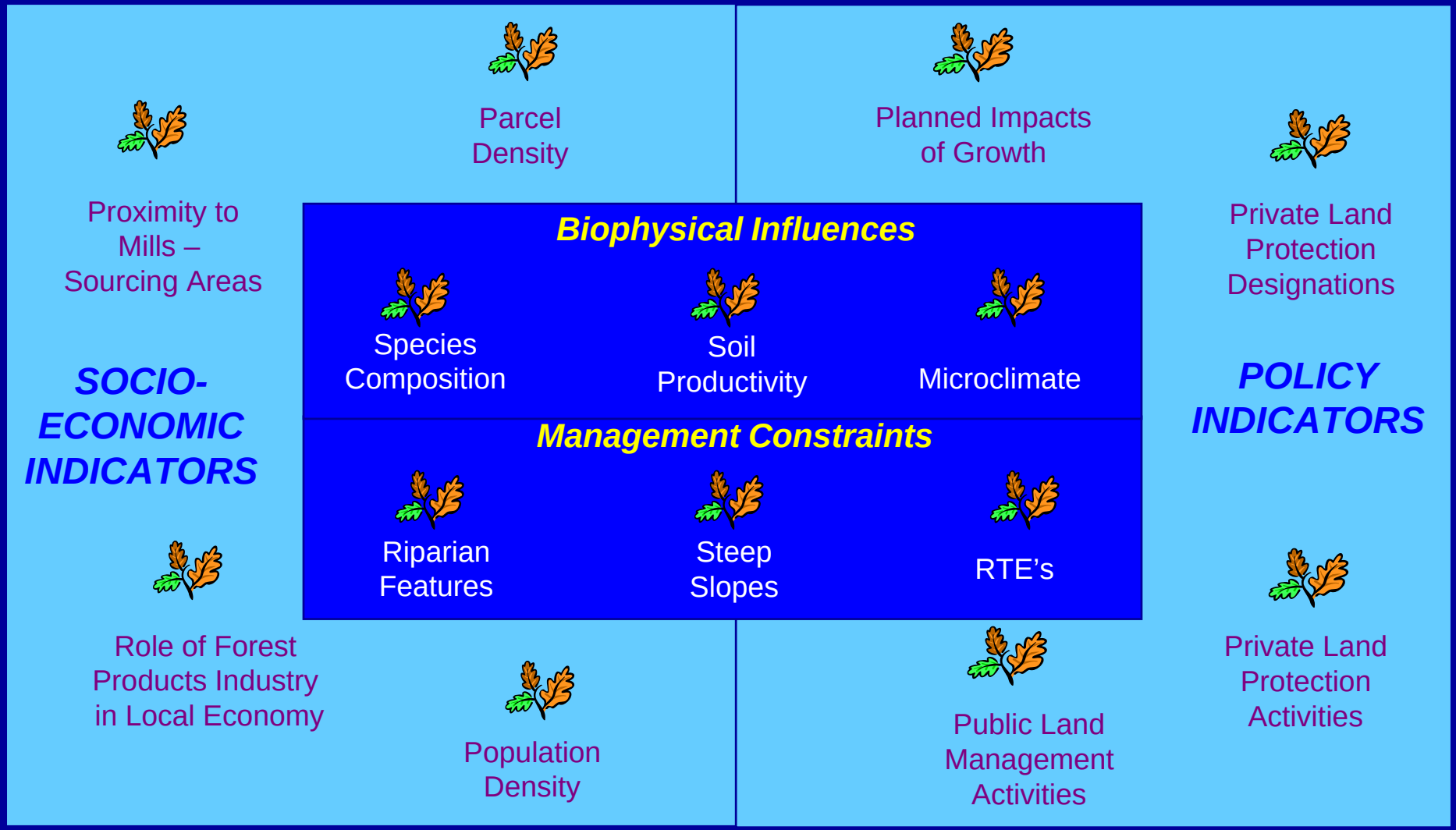
Ecological **Model**

Economic **Model**

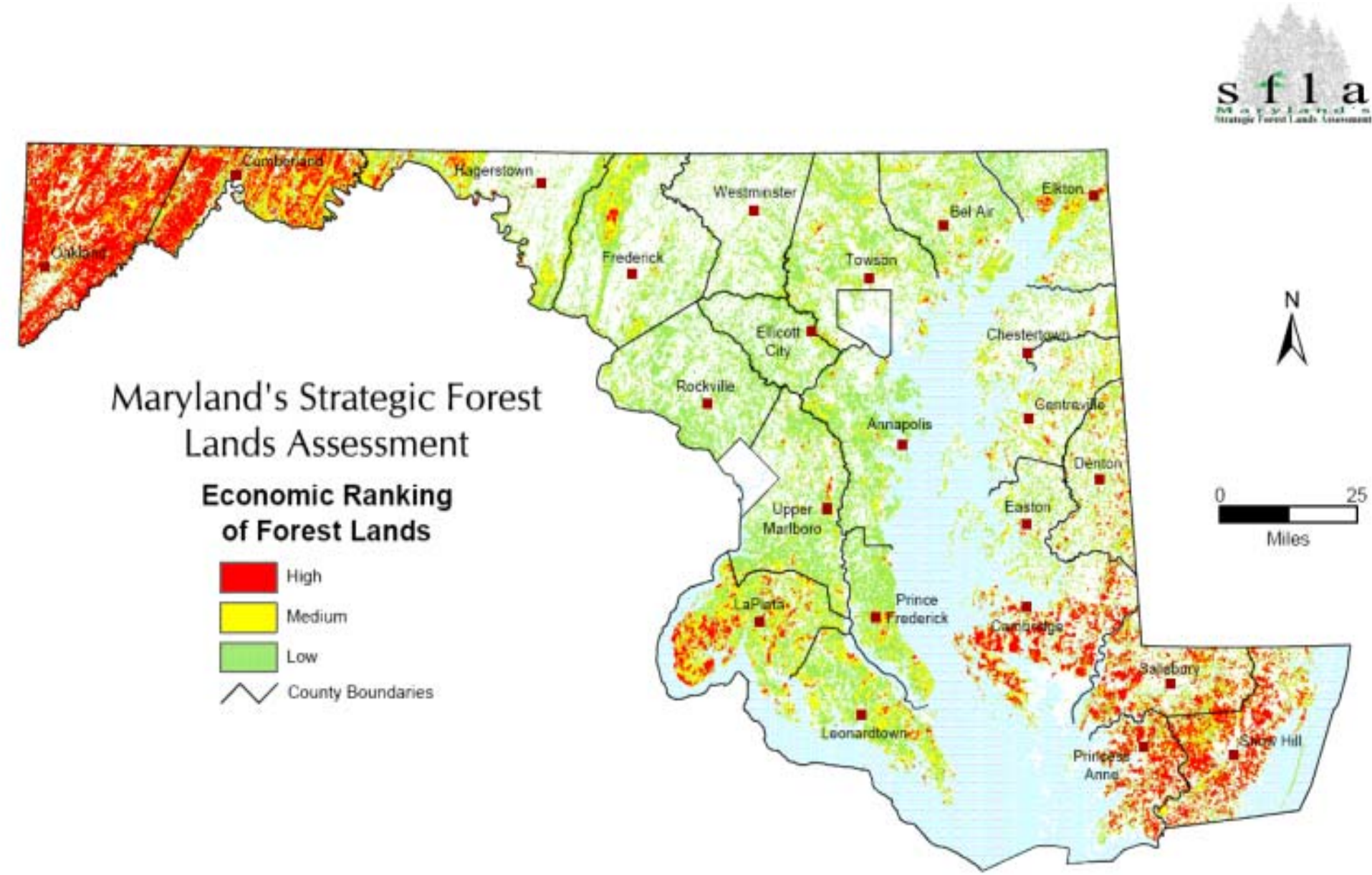
Vulnerability **Model**



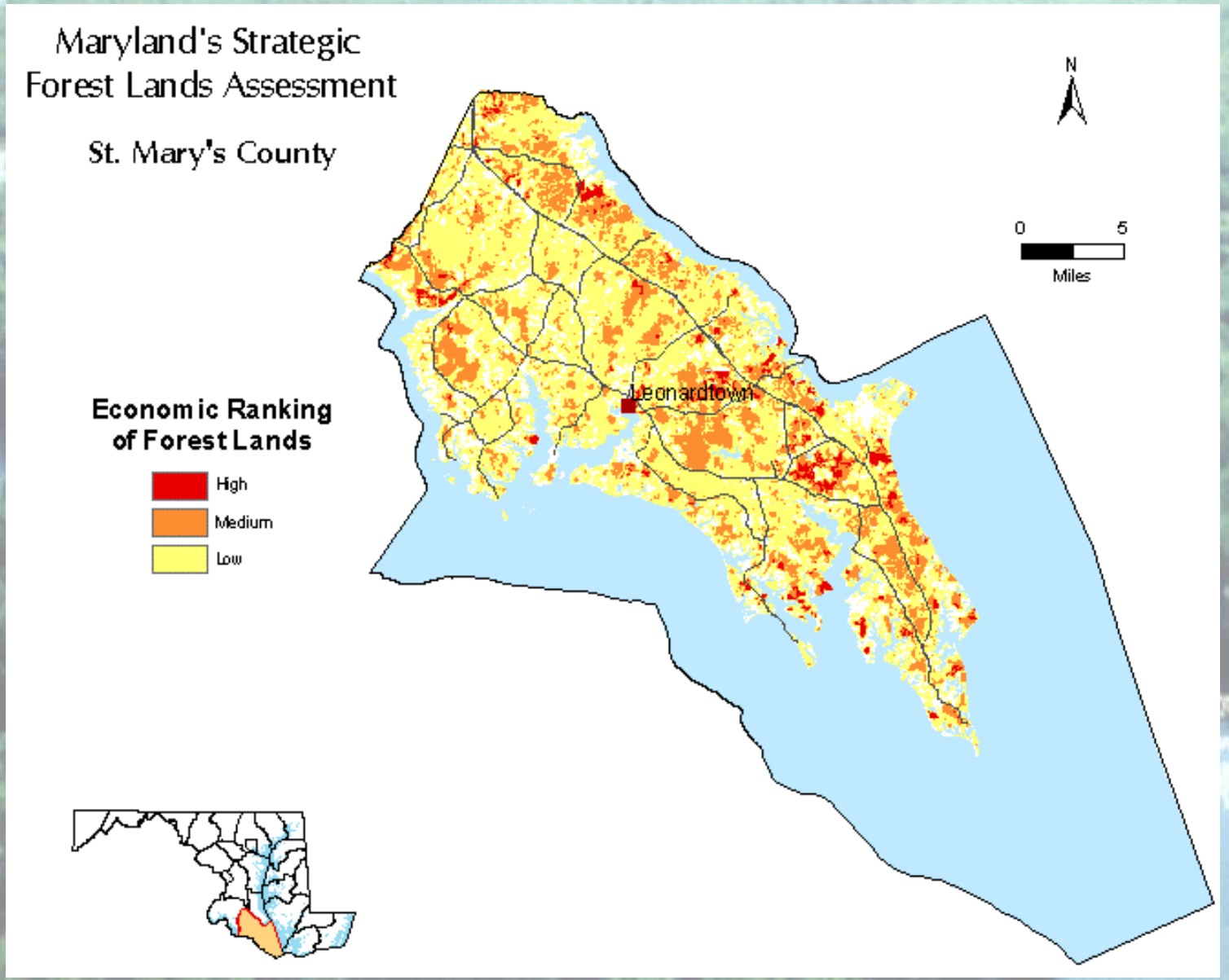
Defining **Economically** Important Forest Lands



Regional Indicators


sfla
Maryland's
Strategic Forest Lands Assessment
Maryland's Strategic Forest Lands Assessment
Economic Ranking of Forest Lands
High
Medium
Low
County Boundaries
Cumberland
Hagerstown
Oakland
Frederick
Westminster
Towson
Bel Air
Elkton
Ellicott City
Rockville
Annapolis
Chestertown
Centreville
Denton
Easton
Upper Marlboro
LaPlata
Prince Frederick
Cambridge
Salisbury
Leonardtown
Princess Anne
Snow Hill
N
0
25
Miles

SFLA Economic Model



MARYLAND'S
LAND CONSERVATION PROGRAMS

PROTECTING THE CHESAPEAKE BAY WATERSHED

Robert L. Erhlich, Jr.
Governor

Michael S. Steele
Lt. Governor

Lewis R. Riley
Secretary
Department of Agriculture

James "Chip" DiPaula
Secretary
Department of Budget and Management

C. Ronald Franks
Secretary
Department of Natural Resources

Audrey Scott
Secretary
Department of Planning

December 2003

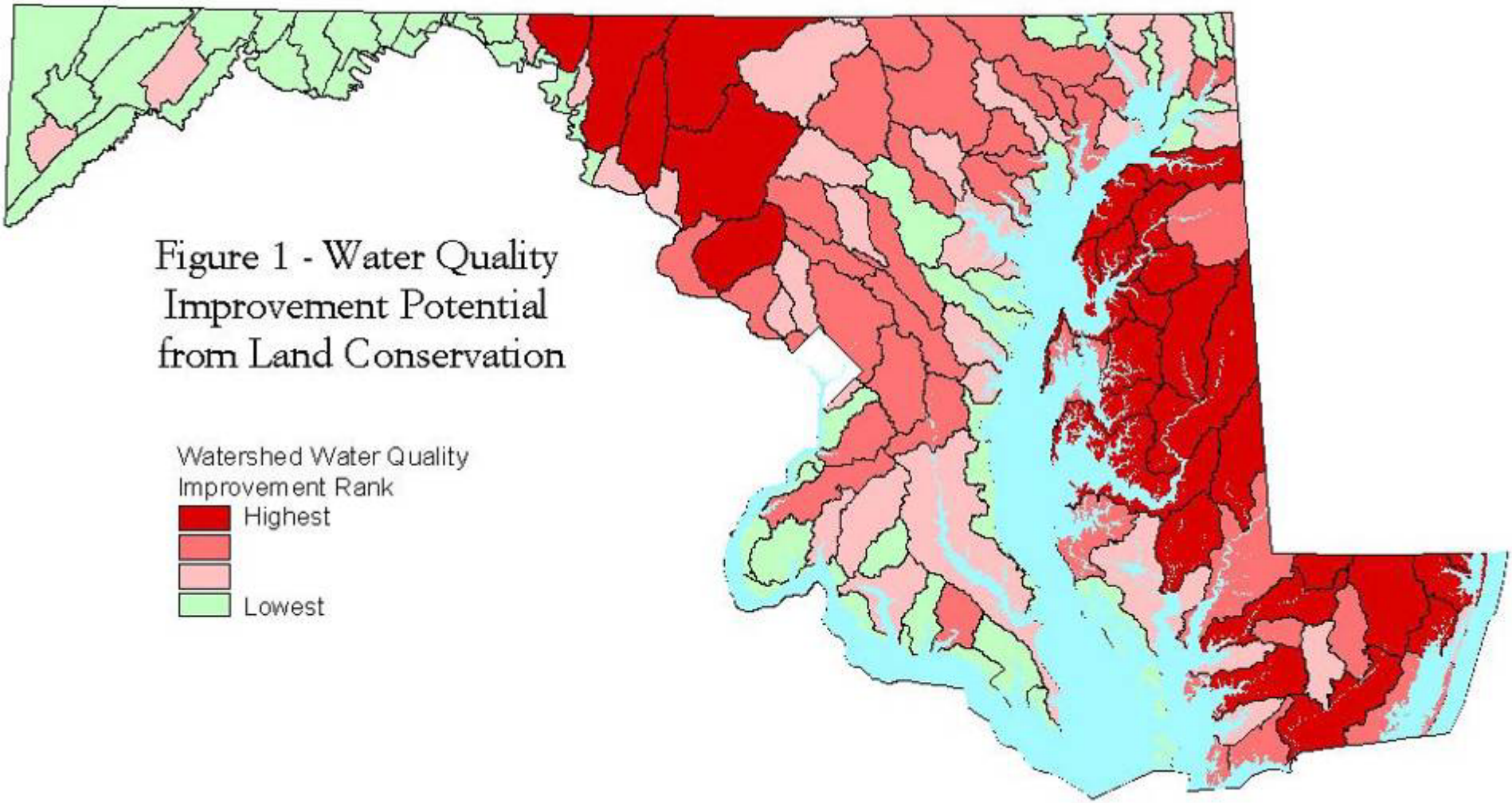


Figure 1 - Water Quality Improvement Potential from Land Conservation
Watershed Water Quality Improvement Rank
Highest
Lowest

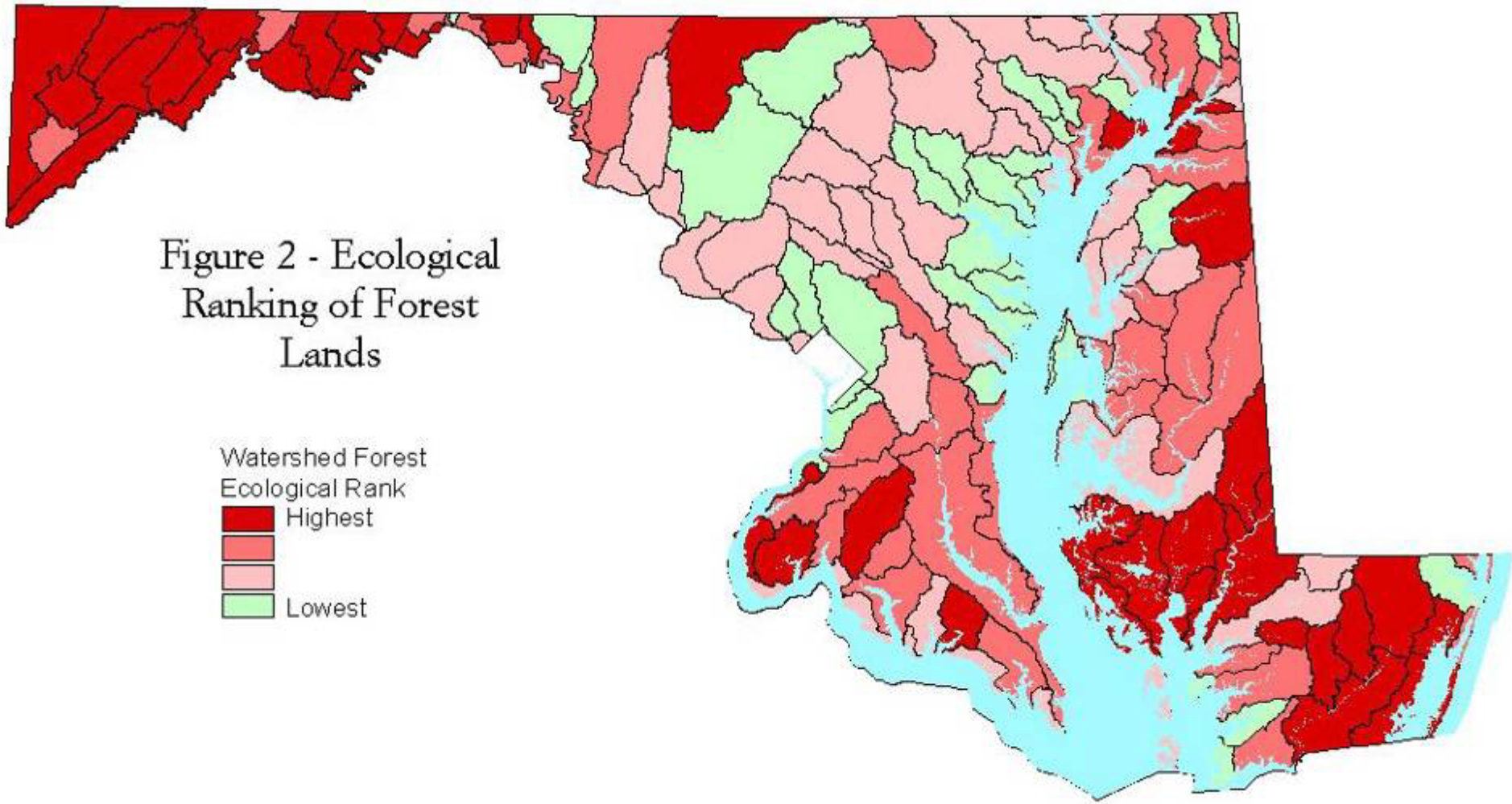


Figure 2 - Ecological Ranking of Forest Lands
Watershed Forest Ecological Rank
Highest
Lowest

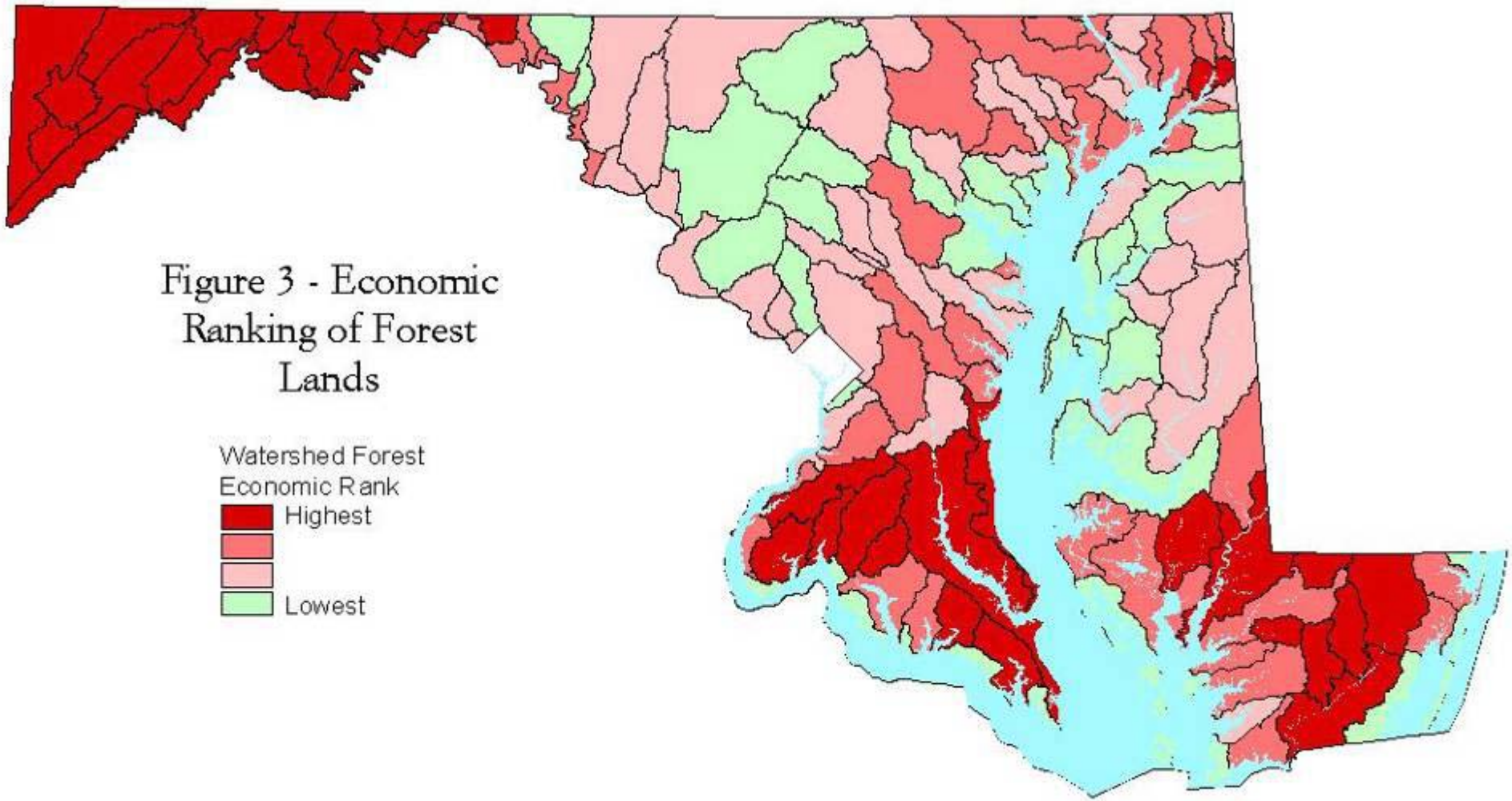


Figure 3 - Economic Ranking of Forest Lands
Watershed Forest Economic Rank
Highest
Lowest

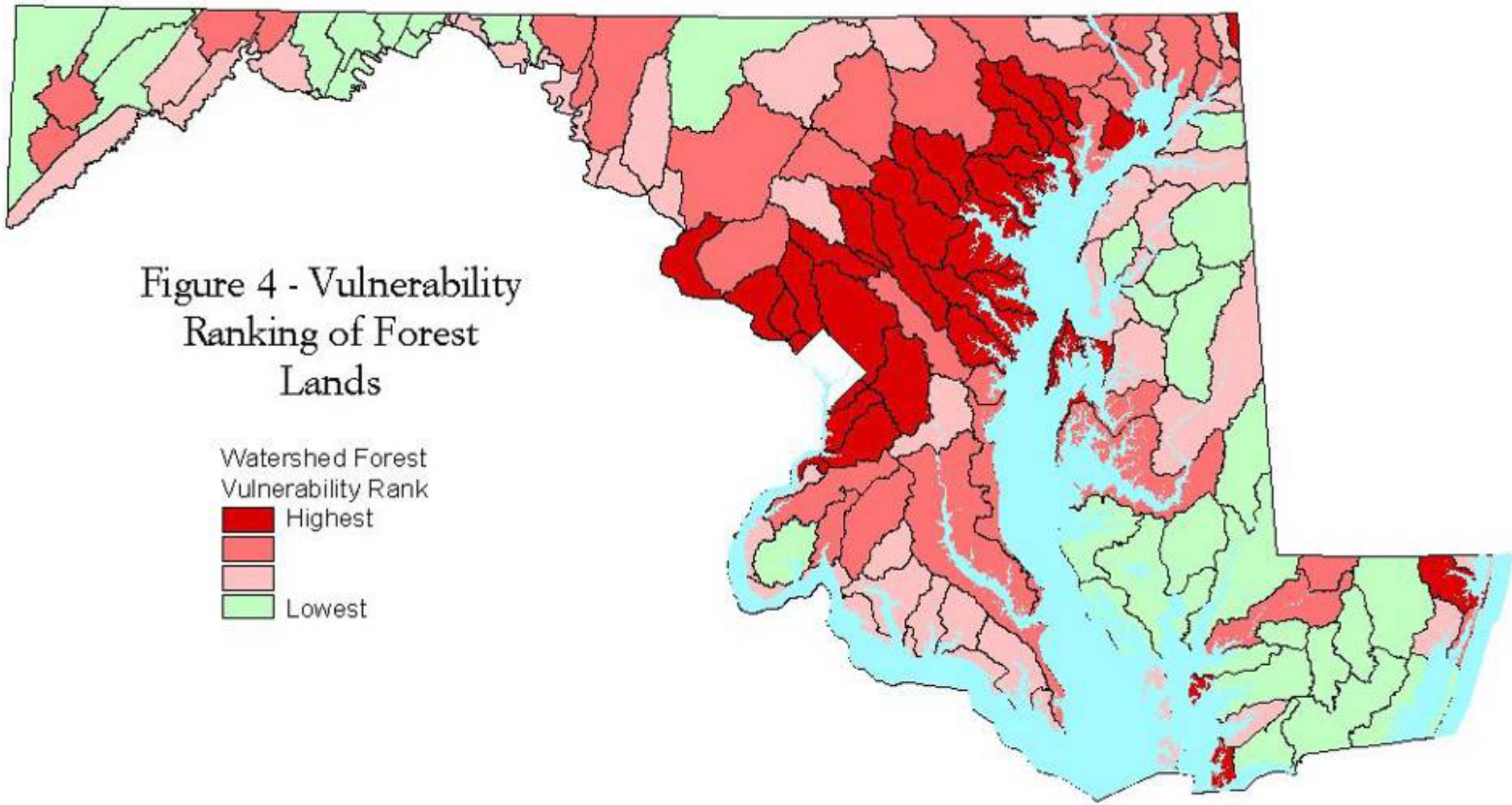


Figure 4 - Vulnerability Ranking of Forest Lands
Watershed Forest Vulnerability Rank
Highest
Lowest

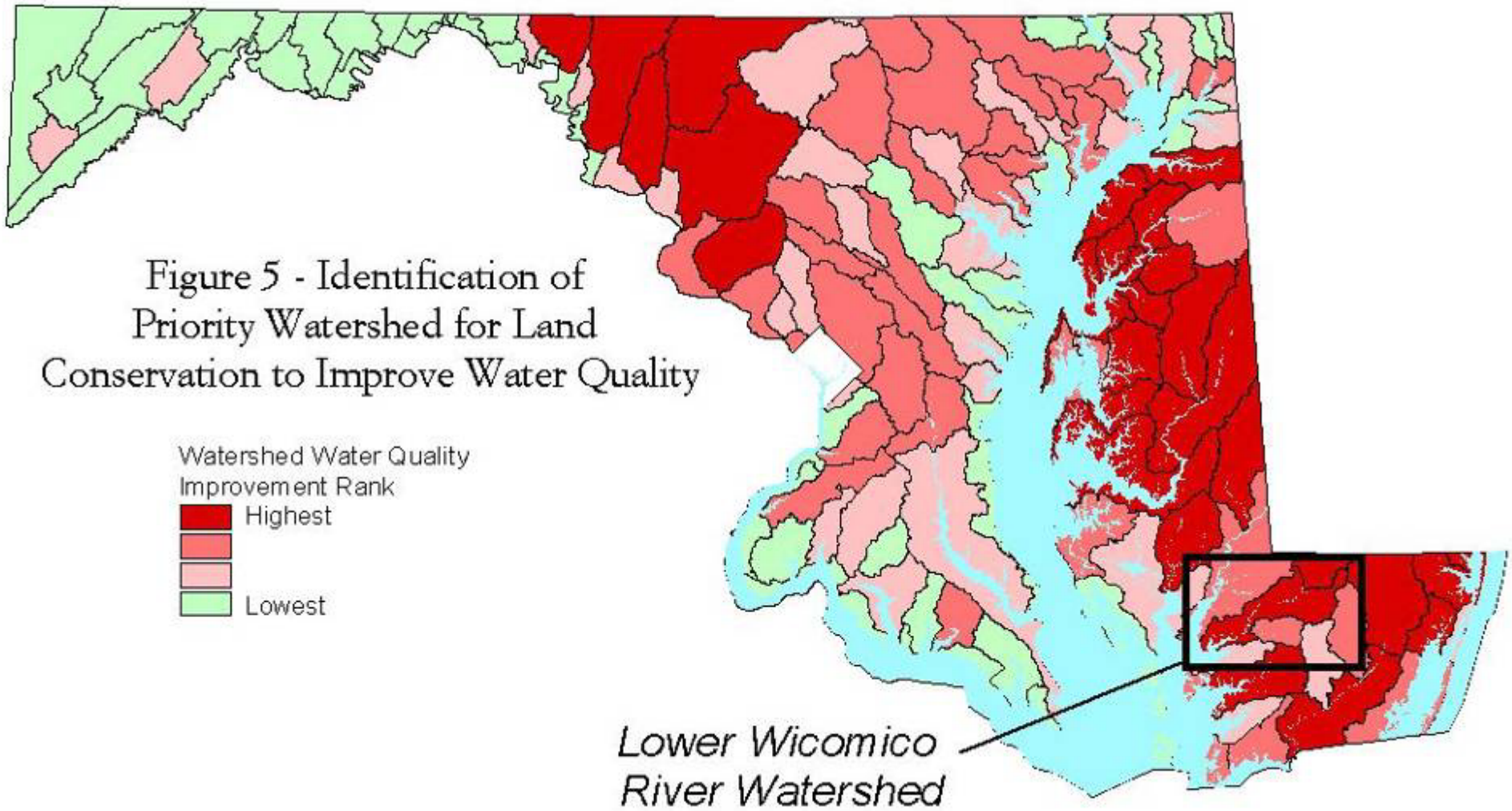
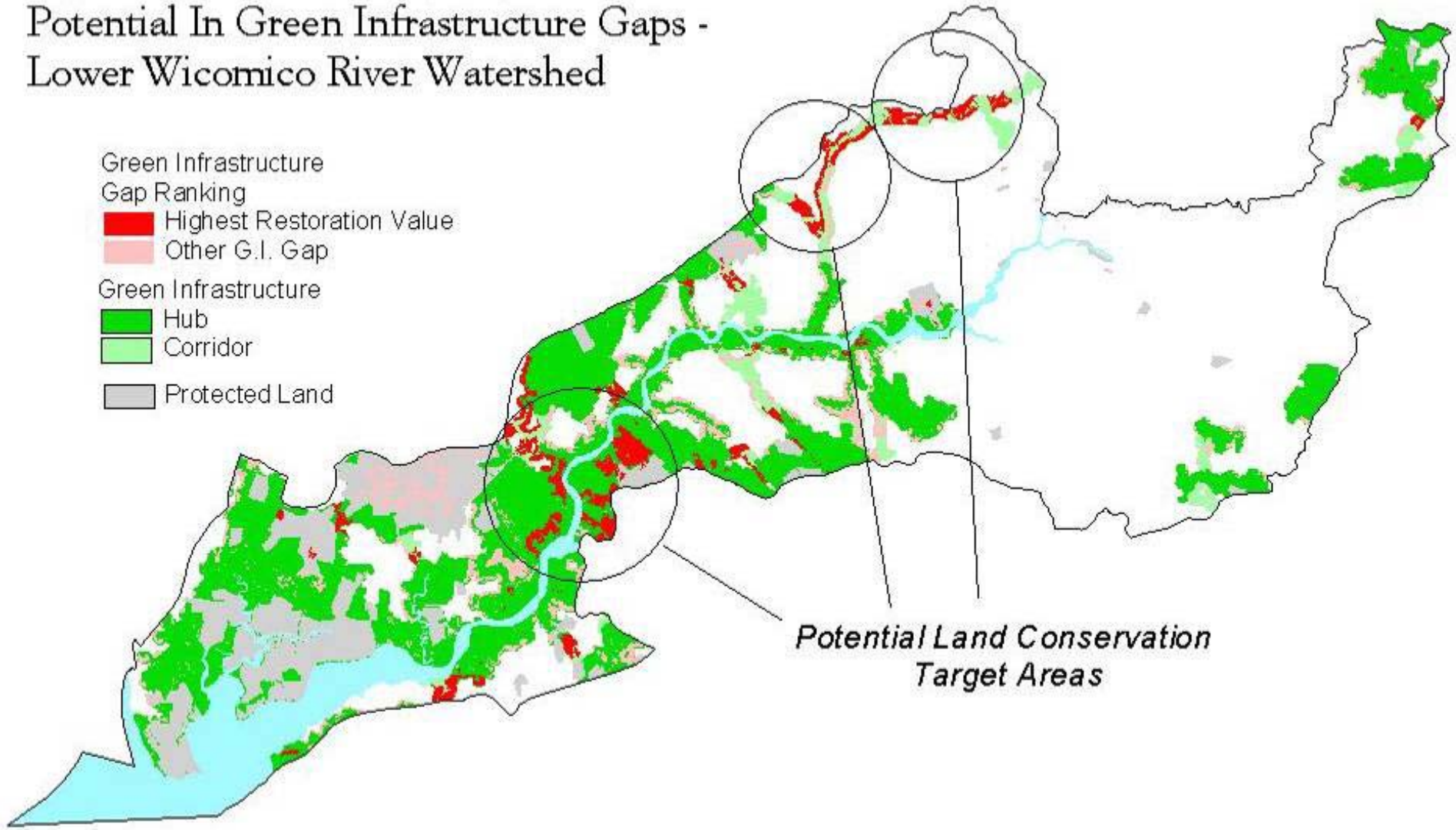


Figure 5 - Identification of
Priority Watershed for Land
Conservation to Improve Water Quality
Watershed Water Quality
Improvement Rank
Highest
Lowest
Lower Wicomico
River Watershed

Figure 6 - Water Quality Improvement Potential In Green Infrastructure Gaps - Lower Wicomico River Watershed



Combining Multi-scale Watershed and Landscape Data to Target Implementation Activities

Toolkit Demonstrations | Preferences | Indicator Summaries | Integration Methods | Future Scenarios | Region Map | Download | Indicators

Weight by Indicators Map for Maryland

Display ◉ Static *or* ○ Interactive

Display Map with ◉ Watersheds *or* ○ EMAP Hexes

Data for map Current Data

	0	1	2	3	4	5	6	7	8	9	10
Forest land cover along streams	○	◉	○	○	○	○	○	○	○	○	○
Nitrogen in surface water	○	◉	○	○	○	○	○	○	○	○	○

<< Back | Construct Map

STATS / GRAPHS POWERED BY Insightful

Weight by Indicators Map for Maryland

Display ◉ Static *or* ○ Interactive

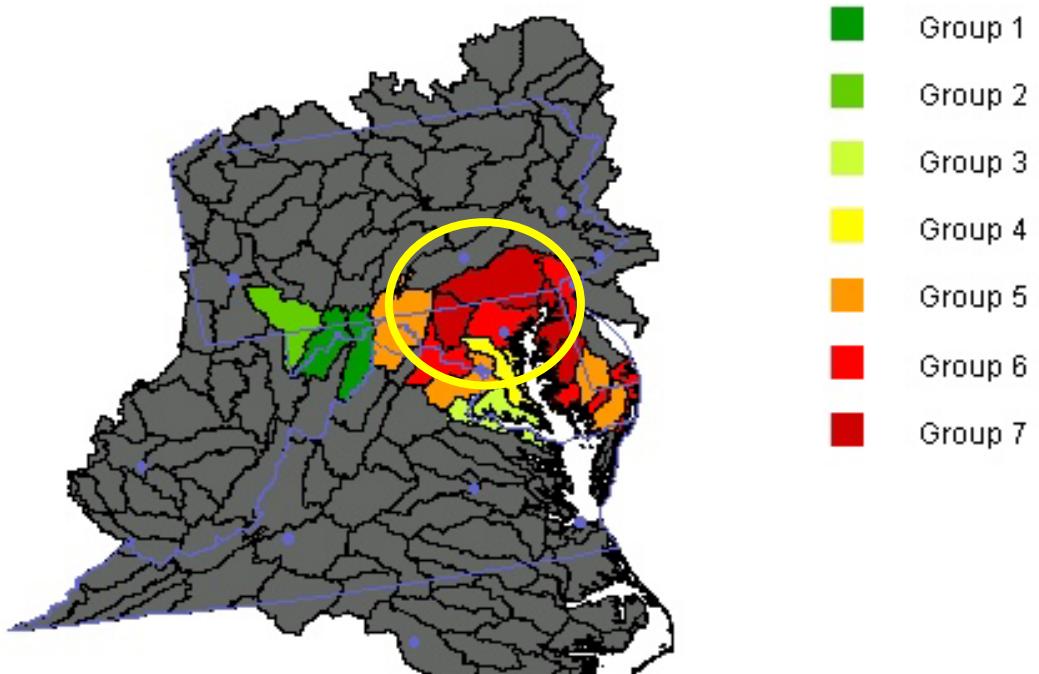
Display Map with ◉ Watersheds *or* ○ EMAP Hexes

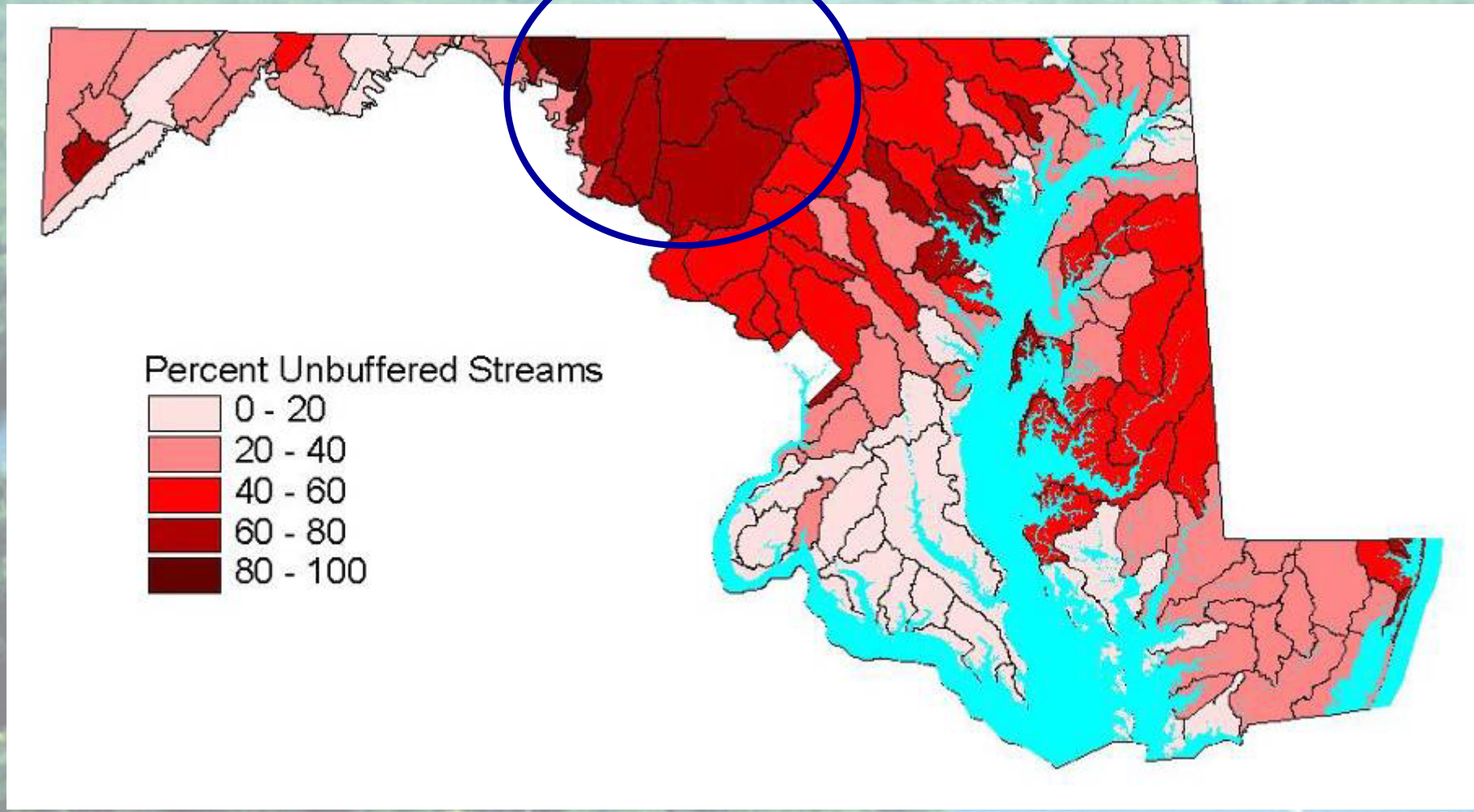
Data for map Current Data

	0	1	2	3	4	5	6	7	8	9	10
Forest land cover along streams	○	◉	○	○	○	○	○	○	○	○	○
Nitrogen in surface water	○	◉	○	○	○	○	○	○	○	○	○

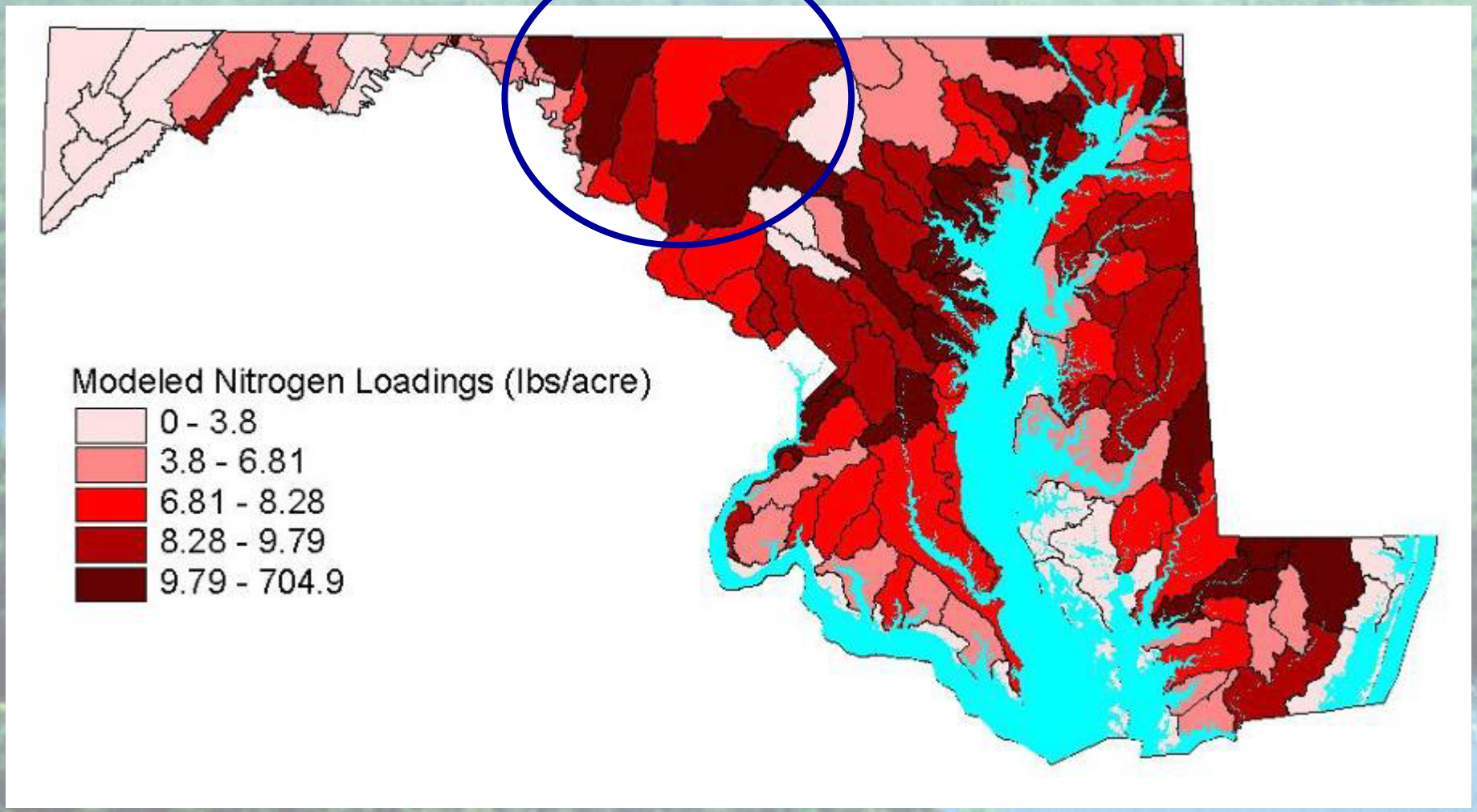
<< Back | Construct Map

Weighting by Indicators





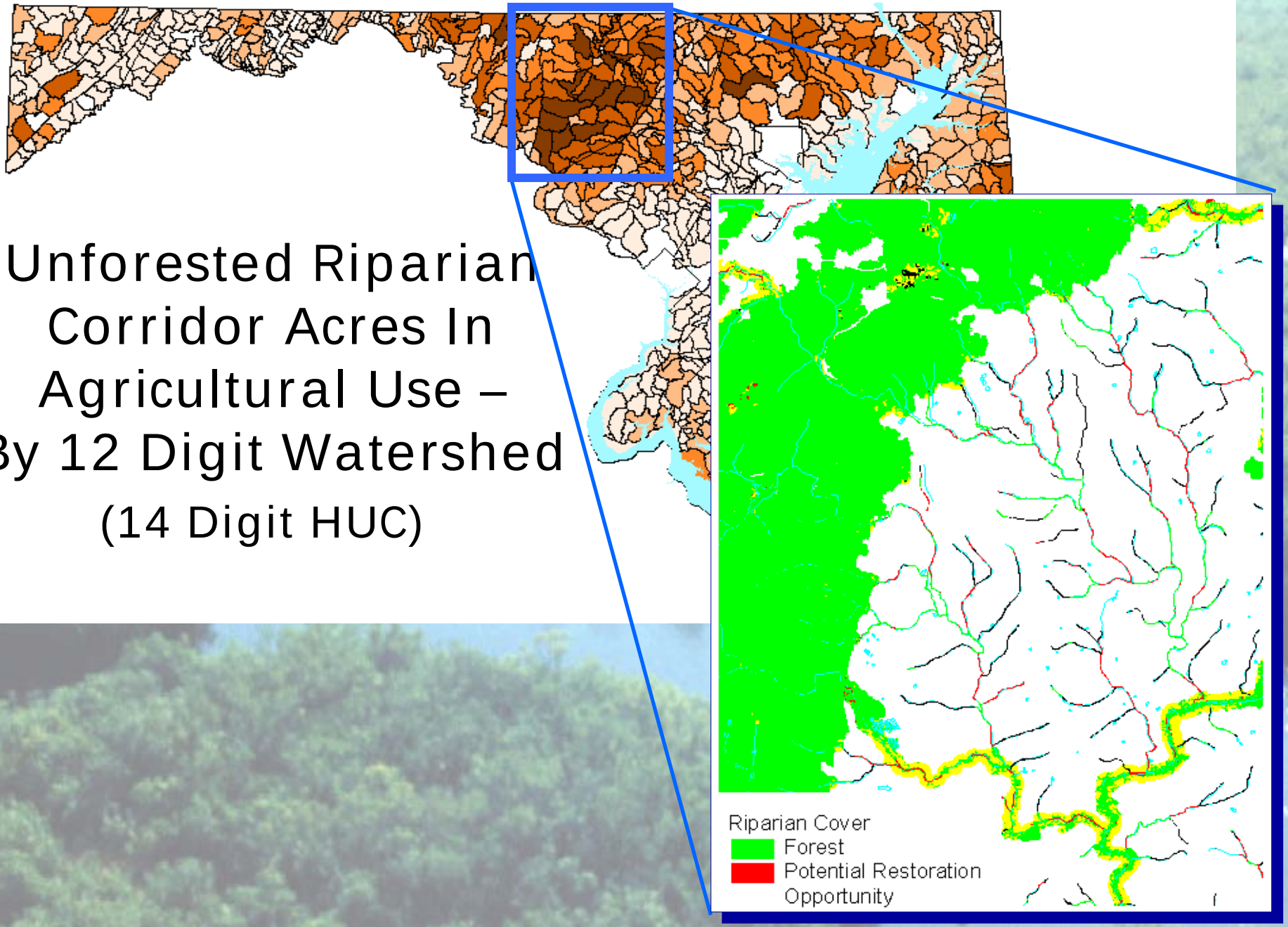
Riparian Forest Cover by 11Digit HUC

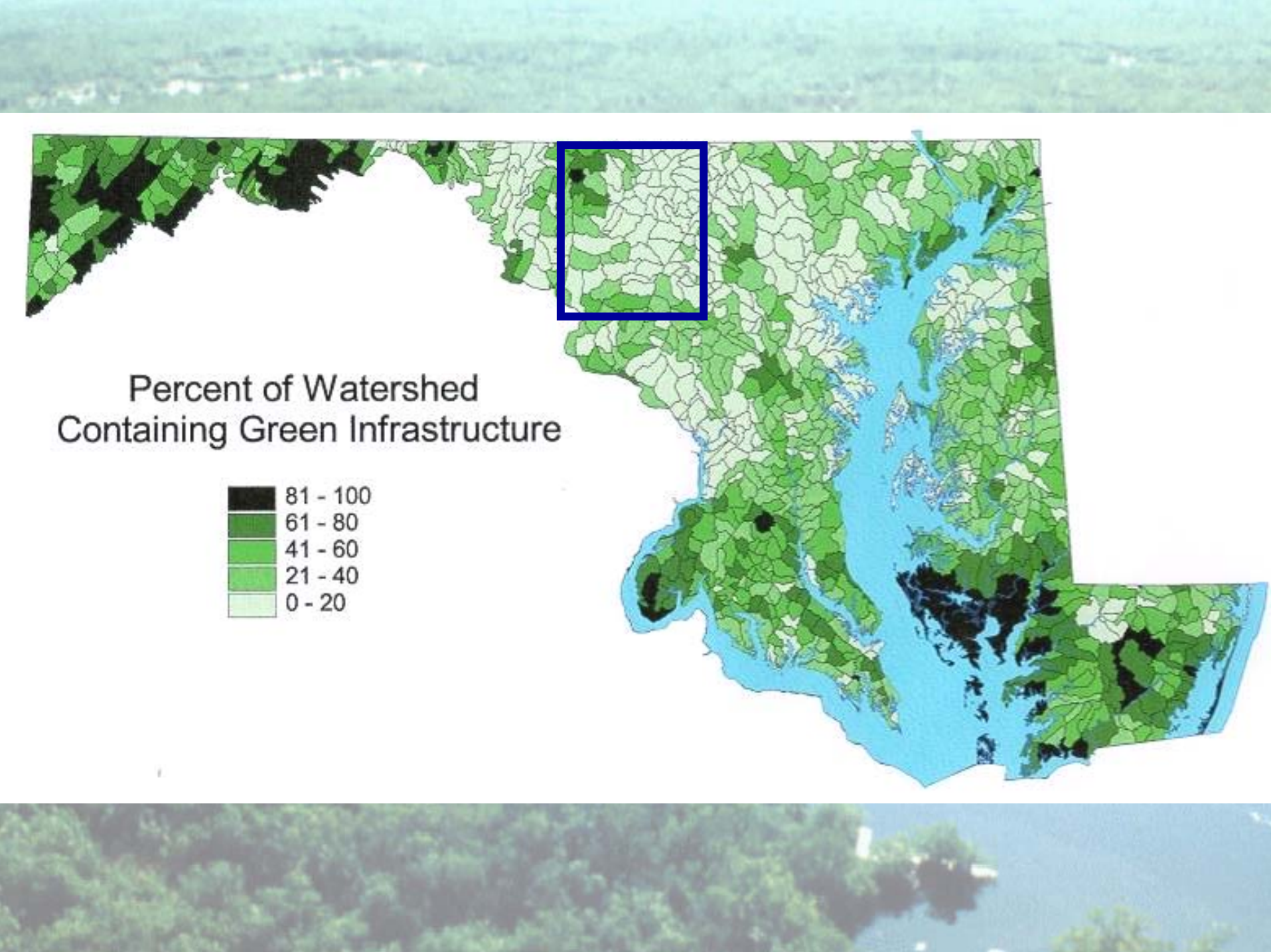


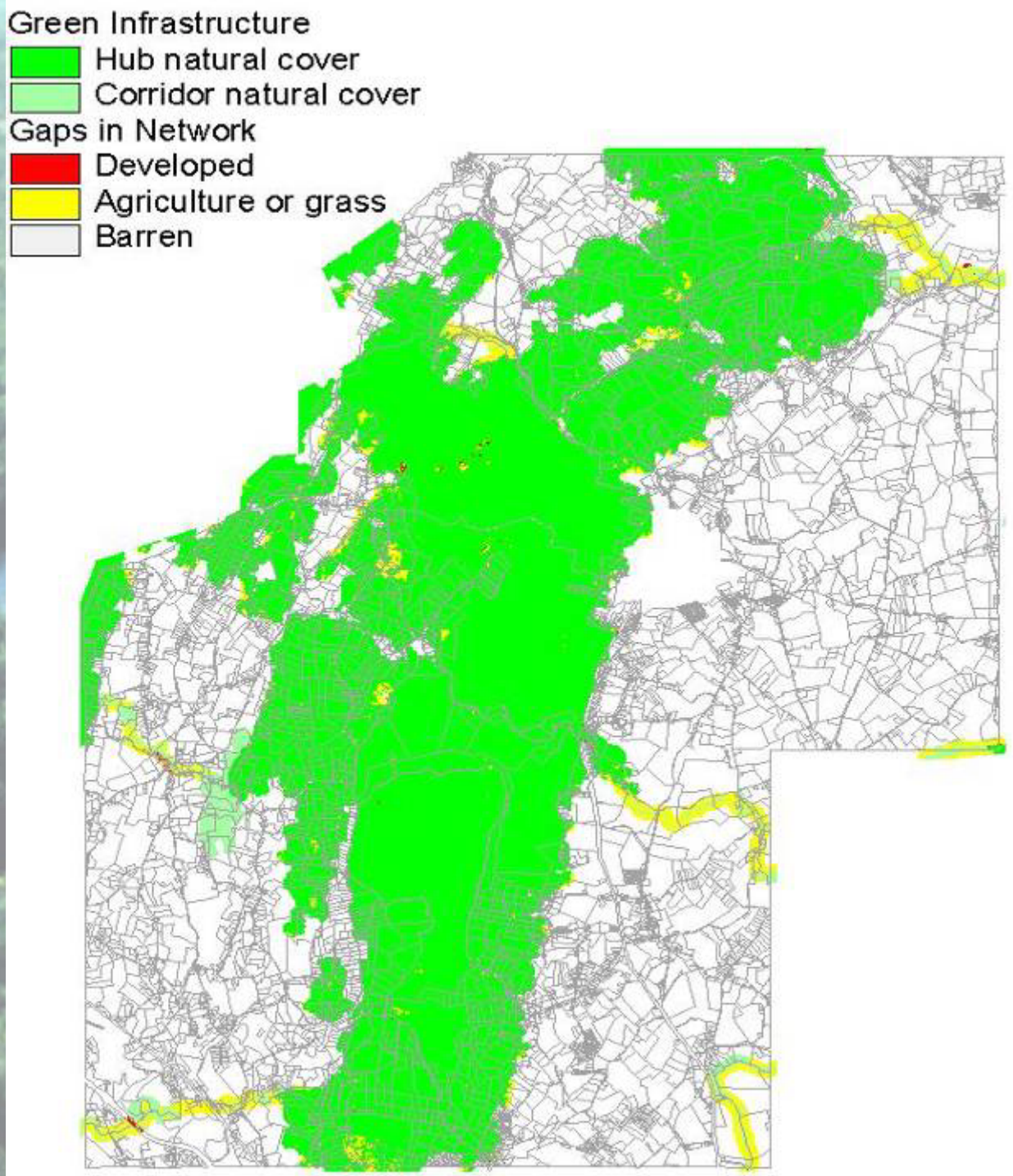
Nitrogen Loadings by 11Digit HUC

Unforested Riparian Corridor Acres In Agricultural Use – By 12 Digit Watershed

(14 Digit HUC)

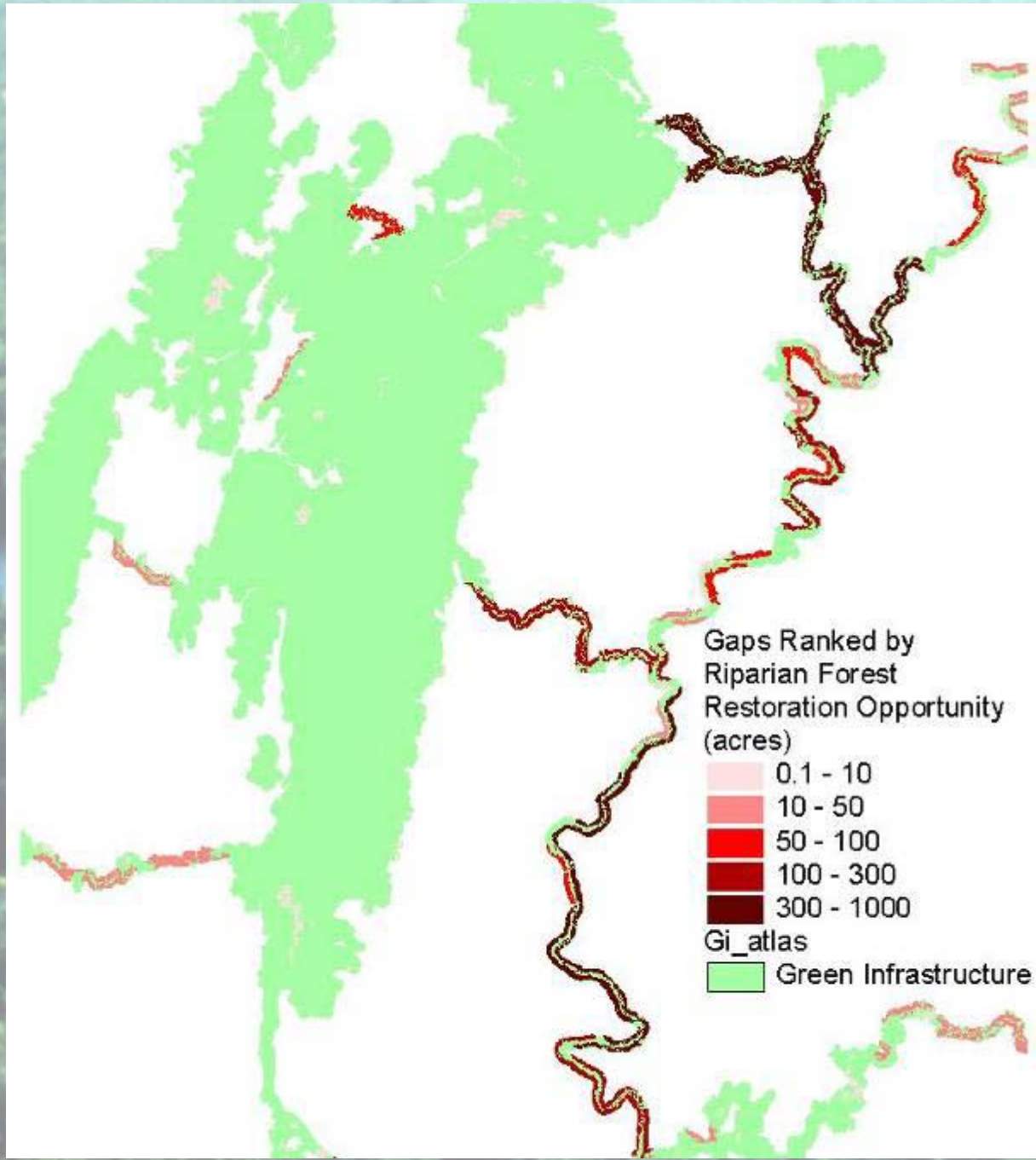



Percent of Watershed
Containing Green Infrastructure
81 - 100
61 - 80
41 - 60
21 - 40
0 - 20



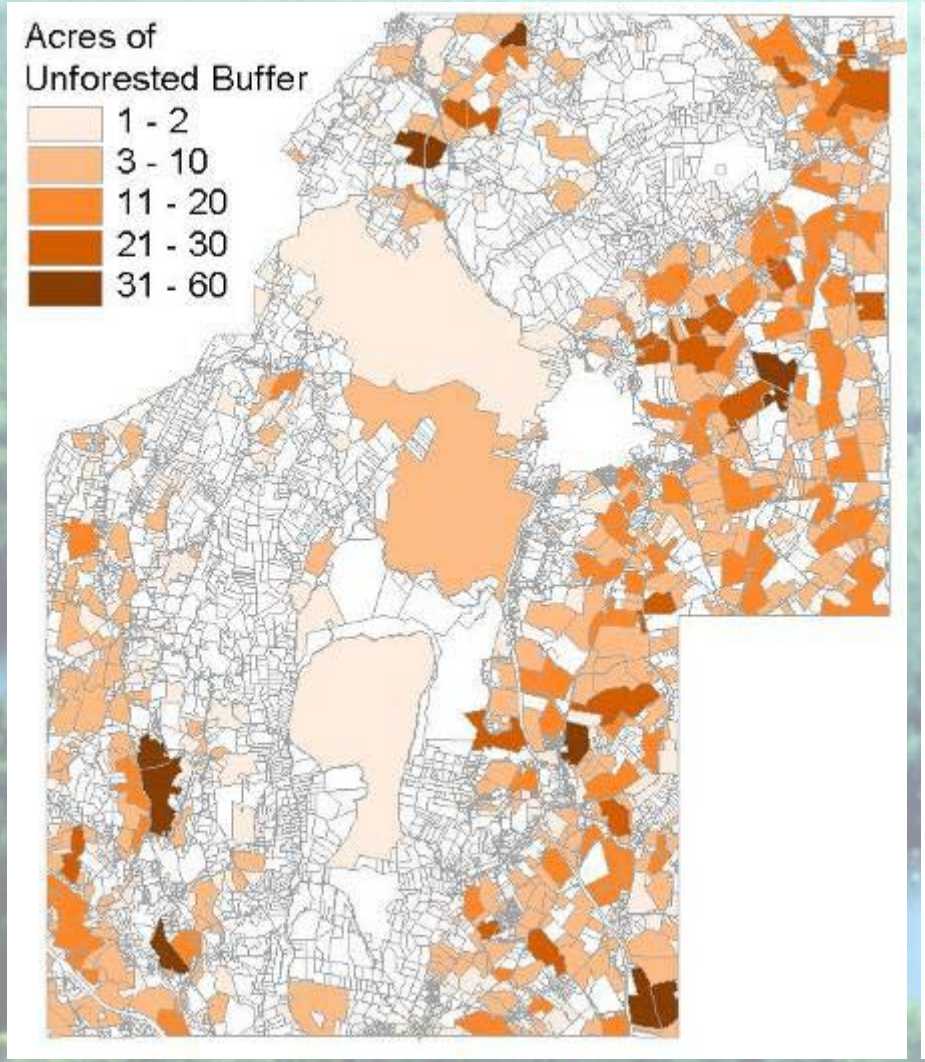
Upper Monocacy Watershed/ Catoctin Mountain Region

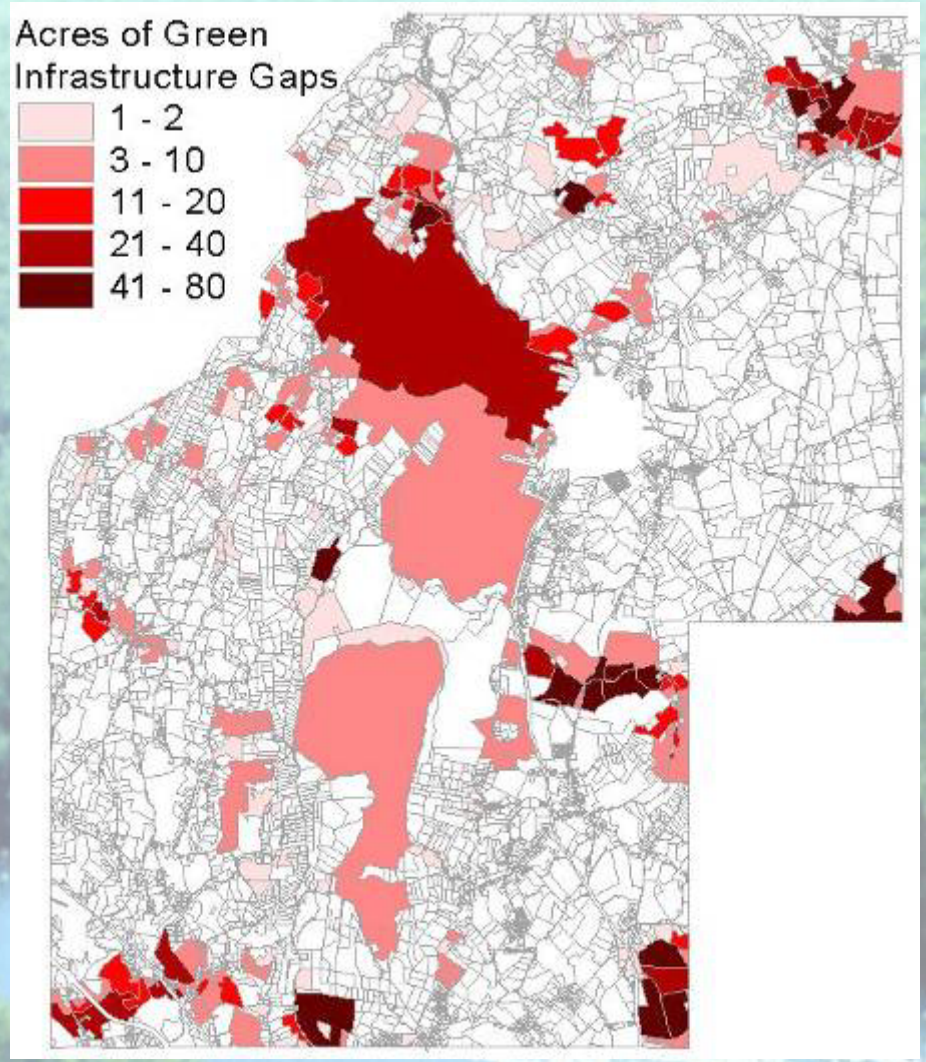
Green Infrastructure Gaps



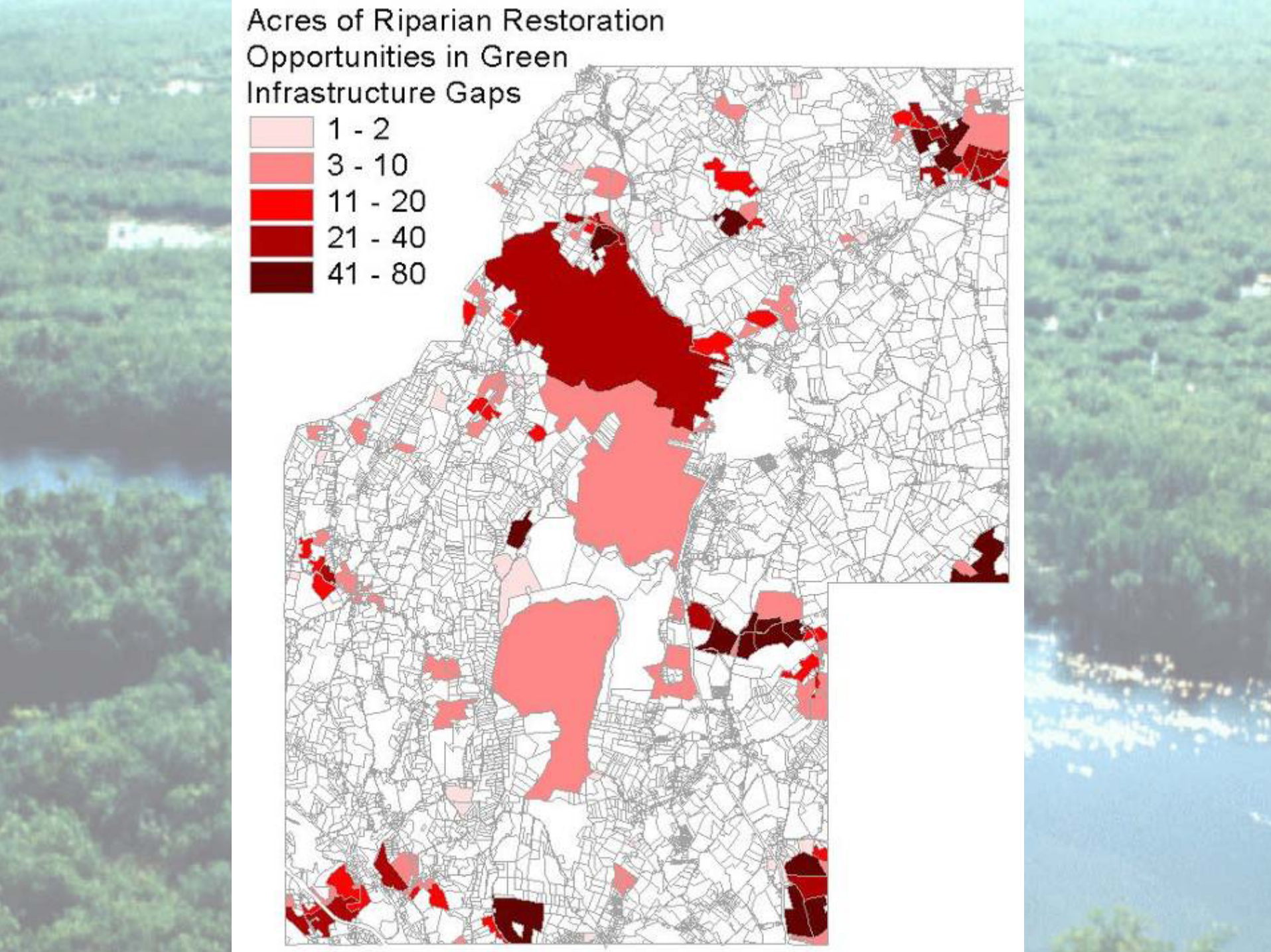
Upper Monocacy Watershed/ Catoctin Mountain Region

Riparian Buffer Planting Opportunities in Green Infrastructure Gaps Within High Nutrient Load Watersheds





Upper Monocacy Watershed/ Catoctin Mountain Region Parcels


Acres of Riparian Restoration Opportunities in Green Infrastructure Gaps
1 - 2
3 - 10
11 - 20
21 - 40
41 - 80